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#0000 6208

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

ENGINEERING ORDER

TYPE OF PACKAGE	TYPE OF FUNDING (check one)	WORK PERFORMED BY (check one)
☐ REVIEW	☒ AUTHORIZATION JOB	☐ MAINTENANCE ☐ OTHER _____
☒ FINAL	☐ WORK ORDER (WCF)	☐ ON SITE CONTRACTOR
☐ OTHER_____	☐ OTHER _____	☒ OTHER CONTRACTOR

DOCUMENT TYPE (CHECK ONE)	OTHER (SPECIFY)	
☐ TITLE I DESIGN MODIFICATION PACKAGE	☐ ENGINEERING CHANGE REQUEST (ECR)	☐ STATEMENT OF WORK (SOW)
☐ TITLE II DESIGN MODIFICATION PACKAGE	☐ CONCEPTUAL DESIGN REPORT (CDR)	☐ CONTRACT MODIFICATION / ADDENDA
☐ TITLE III AS-BUILT PACKAGE	☐ DESIGN CRITERIA (DC)	☐ ENGINEERING ANALYSIS / STUDY
☐ MINOR MODIFICATION (MM)	☐ PLANT STANDARD	☐ SAFETY EVALUATION REPORT (SER)
☒ GEN ENG SERVICES PACKAGE (GES)	☐ DESIGN / PURCHASE SPECIFICATION	☐ TEST PROCEDURE

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Fifteen Sets of Drawings Rushed to G. Pickerel. Copies of Specs to Follow 10/12/95 BDM

Put Acad dwg files on CV system Oct 10, 1995 Kieth MacCloud

BDM

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PROJECT / WCR NUMBER	BLDG	TITLE
989035	Site	Passive Seep Collection and Treatment (PSCT)

ECR #	INITIATOR (Print/Sign)	DATE	EXT / Pager
	Greg Pickerel Greg Pickerel	10/5/95	5634/5786

Additional / Related Job #	EO COORDINATOR (Print/Sign)	DATE	EXT / Pager
	Blair Madsen BL Madsen	10/12/95	4372/7164

EO #	Sub #	REF EO #	EO DISTRIBUTION DATE	EO CHARGE NUMBER
37627	GES001			

DES 253/1 1(2) 01/24/95

ADMIN RECORD
BZ-A-000477

1/223

EG&G ROCKY FLATS
Engineering and Technology

PROJECT COVER/INDEX SHEET

PROJECT NUMBER: 989035

IS THIS A TEMPORARY MODIFICATION? ☐ YES ☒ NO TM# _____

TITLE: Passive Seep Collection and Treatment Ou-7 DATE: 10/5/95

TEAM MEMBERS: G Pickerel of Eng, _____ of ___, _____ of ___, _____ of ___,
_____ of ___, _____ of ___, _____ of ___, _____ of ___, _____ of ___

B = Technical Baseline (To be as-built) R = Reference (Not to be as-built) I = For Implementation of work or distribution S = Supporting (Not for distribution) Date = Date of Issue

Document Description, Number	B or R		I or S		Date
NOTE Documents not kept in Engineering Documentation which are listed shall reference the storage location					
Technical Specifications		R	I		10/5/95
Drawings 51267-0101		R	I		9/21/95
51267-0102		R	I		9/21/95
51267-0103		R	I		9/21/95
51267-0104		R	I		9/21/95
51267-0105		R	I		9/21/95
51267-0106		R	I		9/21/95
51267-0107		R	I		9/21/95
GES Screen		R		S	10/5/95
System Classification Form		R		S	10/5/95
Technical Scope Covered by Tech Specifications					

Preparer. Greg Pickerel 10/5/95 print/sign/date

Approval Greg Pickerel 10/5/95 (PCE) print/sign/date

Checker _____ print/sign/date

H&S Design Review Ken Jenkins 10/6/95 print/sign/date

Interdiscipline Concurrences:

_____ print/sign/date

_____ print/sign/date

Other Concurrences

_____ print/sign/date

_____ print/sign/date

Attach continuation page(s) if needed

DES 207/8 8(8) 05/01/95

2

SYSTEM CLASSIFICATION FORM

AUTHORIZATION/ WORK CONTROL NO 989035 TITLE Passive Seep Collection and Treatment

System Name Landfill Leachate Collection

Bldg.: Site Location: Old Landfill

6 1.1 SYSTEM REFERENCE DOCUMENTS OU 7 IAG Decision Document

6 1.2 SYSTEM FUNCTIONS AND OPERATING MODES

NOTE: This is a prework classification and must remain with and govern all work to SSCs until all work and document changes are complete

Functions to collect seep water and treat before release. The water is currently not being treated and there are no ARARS to meet

6 2 SYSTEM CATEGORY CLASSIFICATION

NOTE Identify references from those documents listed in Section 6 1 1 and enter technical justification on appropriate space below

Category 1 ☐ 2 ☐ 3 ☐ 4 ☒

Technical Basis

This system is classified as Cat 4 because it does not fit into the other categories. The system is a Non Safety Class item.

Cognizant Engineer	Prin Name	Cognizant Engineer Signature	Ext/JOP	Date
Greg Pickrell		Greg Pickrell	5634/5786	10/5/95

DES 2232 1(1) 03 10 95

3

GES SCREEN

Job#. 989035 Bldg Site

Title: Passive Seep Collection and Treatment OU-7

Description: Collect OU-7 Seep H2O and treat
Release to OU-7 Pond

SECTION A - NUCLEAR WORK PROCESS REQUIRED	Y	N
1. Does work affect/modify Vital Safety Systems?	__	X
a. Modify VSS hardware, software or require a change in VSS?	__	X
b. Impact a vital safety function during installation, modification, or repair?	__	X
c Will this work create a "Violation" with respect to any Criticality Safety Operating Limit (CSOL) or Nuclear Material Safety Limit (NMSL), or is a new CSOL or NMSL required?	__	X
d. Will this work require any modification, addition or deletion of an existing VSS procedure?	__	X
e. Will this work impact any system for which credit is taken in an Operational Safety Requirement (OSR)?	__	X
f Will this work create an "Out-of-Tolerance" with respect to an OSR Limiting Condition of Operation (LCO)?	__	X
2 Does work involve Hazardous Chemicals of sufficient quantity and/or type to pose potential for catastrophic events? (If applicable, refer to COEM-DES-223, Appendix 6)	__	X
SECTION B - SAFEGUARDS AND SECURITY SYSTEMS		
1 Does work affect Safeguards and Security Systems?	__	X

SECTION C - GENERAL ENGINEERING SUPPORT PROGRAM (GES) ELIGIBILITY

If the answer to any of the above questions is "yes," then this modification does not qualify for GES If all answers are "no," use GES program. Tasks "failing" the screen may still use GES program, if Appendix 7 and Section 6 4 for the EDMPP development is approved by E&SS management

1 Work is assigned to GES program

Preparing Engineer

10/5/95
Date

Technical Specifications

Passive Seep Collection and Treatment System

Operable Unit No. 7

Revision 1

September 1995

U S Department of Energy
Rocky Flats Environmental Technology Site
Golden, Colorado

5

Technical Specifications
Passive Seep Collection and Treatment System
Operable Unit No. 7

APPROVED BY:

Landfill Closures Manager	Date
Project Manager	Date
QA Manager	Date

Table of Contents

SECTION 02200 - EARTHWORK

1. Part 1 General

Note In drawings and specifications, "Contractor" refers to RMRS and "Subcontractor" refers to bidder

1 1 Summary

1 1 1 Section includes clearing and grubbing, excavation, trenching, bedding, backfilling, compaction, and grading associated with the sitework and other work required for this project

1 1 2 Excavation occurs within wetland area Damage to wetlands shall be minimized by Subcontractor and shall be confined to "Extent of construction" zone as marked on plans

1 2 Related Sections

1 2 1 Section 01300 – Submittals (see Contract Document)

1 2 2 Section 01700 – Construction Safety Requirements (see Contract Document)

1 2 3 Section 02935 – Riprap

1 2 4 Section 02970 – Drain Rock

1 2 5 Section 13215 – Piping

1 3 References

The latest issues of the following publications form a part of this specification

1 3 1 ASTM C136, Sieve Analysis of Fine and Coarse Aggregates

1 3 2 ASTM D1556, Density of Soil in Place by the Sand-Cone Method

1 3 3 ASTM D1557, Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10-lb (4 54 kg) Rammer and 18-in (457 mm) Drop

1 3 4 ASTM D2487 Classification of Soils for Engineering Purposes

1 3 5 ASTM D2922, Density of Soil-Aggregate In-Place by Nuclear Method (Shallow Depth)

1 3 6 ASTM D3017, Determination of Moisture Content in Soils by Nuclear Method

1 3 7 ASTM D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1 3 8 ASTM E11, Specification for Wire-Cloth Sieves for Testing Purposes

1 4 Submittals

1 4 1 Comply with "Section 01300 – Submittals " (see Contract Document)

1 4 2 Initial test reports to be submitted by the Subcontractor for approval of the material prior to use, or for imported materials, prior to shipment of the material to the site

1 4 2 1 Granular Material for Pipe Bedding

- Sand Sieve Analysis

  Pipe bedding in trenches shall be a well-graded sand with 100% passing a 4-mesh sieve and 100% retained on a 200-mesh sieve, when tested in accordance with ASTM C136 Sieve sizes shall conform to ASTM E11

  – Submit initial test results indicating compliance to these requirements prior to shipment of the material to the site

- Moisture-Density Relationships

  The Subcontractor shall submit laboratory test results for the moisture-density relationships for the sand (pipe bedding) and import suitable fill material (if used) These will provide the Contractor with the maximum density and the optimum moisture content for the respective materials to be used in the work

- Pea Gravel

  Pea gravel of 3/8-inch diameter may be substituted for sand with approval of Contractor

1 4 2 2 Suitable Fill Material

- Plasticity Index

  At locations where backfill must be placed over piping or under structures, fill material shall be nonexpansive soils (Plasticity Index equal to or less than 12 percent when tested in accordance with ASTM D4318)

  - Submit test results for Plasticity Index for this fill material to be used at these locations (at or under structures or paved areas), indicating compliance to these requirements

  - Note that this suitable fill material may be imported or material excavated from the site trenching/excavations if it meets the specified requirements

- Moisture-Density Relationships same as 1 4 2 1

1 4 3 Proposed excavation, stockpiling, and regrading staging plan describing handling and transport of on-site and off-site materials

2 Part 2 Materials

2 1 Excavated Material

2 1 1 Earth and other materials that can be removed with commercially available excavating equipment Any rock that cannot be removed as described above or other unsuitable material or unacceptable soil encountered shall be removed and disposed at the existing adjacent landfill

2 2 Fill Material

2 2 1 Fill material shall be imported or available on-site soil borrow free from deleterious materials described below under "Unsuitable Materials " The maximum particle size shall be one-and one-half (1½) inches in any direction Acceptable soils are those meeting the requirements of ASTM D2487 for SP-SM, SM, SC, or ML The use of CL or similar materials will require the approval of the Contractor

2 2 2 Unsuitable Materials include all soil materials that contain waste debris, roots organic matter, frozen matter, stone or rock with any dimension greater than 6 inches, or other materials that are determined by the Contractor's representative to be unsuitable for

stable, compacted backfill purposes Unsuitable material shall be removed and disposed at the adjacent landfill

2 3 Equipment

2 3 1 All equipment and tools used in the performance of the work will be subject to approval by Contractor's Site Safety Division before the work is started and shall be maintained in satisfactory working condition at all times

2 3 2 The equipment shall be adequate and shall have the capability of producing the indicated compaction requirements and other quality requirements specified herein

3 Part 3 Execution

3 1 Preparation

3 1 1 Verify all lines, limits, and grades shown on the drawings prior to beginning construction activities

3 1 2 Prior to starting any soil disturbance, excavations, backfilling, or other operations, an approved Integrated Work Control Program (IWCP) package shall be obtained from the Contractor The IWCP package will include an approved soil disturbance plan that contains the information necessary to guide the safe execution of excavation/soil disturbances at the Rocky Flats Environmental Technology Site

3 1 3 Do not divert, remove, or pump any groundwater or water from any trench, manhole, or ditch without approval from the Contractor All water dewatered from excavation and trenching activities shall be pumped to the OU 7 pond upon approval

3 1 4 All streets, roads, grading, structures, utilities, and other improvements not specifically designated to be cleared, removed, stripped, or altered as a part of the work shall be protected from damage throughout the construction period Any damage caused by the Construction Subcontractor, his employees, agents, or any lower-tiered Subcontractors shall be immediately repaired to original condition at no additional cost to the Contractor

3 1 5 Traffic Control

3 1 5 1 The Construction Subcontractor shall provide all necessary barricades, signs, signals, etc , for the protection of the workers and the public, as established by the Occupational Safety and Health Administration (OSHA) Construction Safety and Health Regulation 29 CFR, Part 1926, Subpart G - Signs, Signals and Barricades, and in Subpart P - Excavations, Trenching and Shoring

3 1 6 Existing Utilities

3 1 6 1 Known existing utilities will be indicated in the IWCP and on the drawings The Construction Subcontractor shall hand excavate within 6 feet (or as directed by the Contractor) of areas where existing utilities are indicated

3 1 6 2 Actual locations of all existing utilities within the excavation area shall be located by the Construction Subcontractor by hand excavation

3 1 6 3 After the actual locations and routing of the existing utilities have been found to be accurately determinable through hand excavation, and after approval from the Contractor's construction representative, the Construction Subcontractor may begin excavation using machinery in a manner acceptable to the Contractor

3 1 6 4 After excavation by machinery has begun with the approval of the Contractor, the Construction Subcontractor continues to be fully responsible for all utilities that were found through hand excavation and/or that were indicated on the drawings and IWCP excavation permit

3 1 6 5 Any existing utility in the IWCP and on the drawing that is damaged by the Construction Subcontractor shall be immediately repaired in a manner acceptable to the Contractor and at no additional cost to the Contractor

3 1 6 6 If excavation will be within 10 feet of any existing electrical utility, lockout/tagout procedures are required The Construction Subcontractor shall provide 48-hour prior notice to the Contractor so that the Contractor can arrange for and perform these lockout/tagout procedures

3 1 6 7 Notify the Contractor immediately if any existing utilities that were not indicated are encountered during excavation

3 1 6 8 Obtain approval from the Contractor before backfilling existing utilities Utility warning tape (provided by the Contractor) shall be placed 12 inches above existing utilities

3 1 7 All excavations, trenching, and shoring shall comply with the rules and regulations as established by OSHA Construction Safety and Health Regulations 29 CFR, Part 1926, Subpart P, Excavation, Trenching and Shoring and shall comply with the Rocky Flats Health and Safety Practices (HSP) Manual, Section HSP-12 08 OSHA Pamphlet 2226, Excavation and Trenching Operations, can be used as an additional aid Subcontractor shall comply with OSHA 29 CFR 1910 146, confined space entries, Rocky Flats, H&S Manual Section 6 04

3 1 8 In excavations and trenches, proper allowances shall be made for pipe installation, formwork, concrete work, shoring, inspection, and any other work required in the excavation Bottoms of excavations and trenches shall be level, clean, and clear of loose materials, trash, and debris

3 1 9 Protect bottoms of all excavations from free-standing water and frost All soils in excavations or where fills will be placed shall be protected from movement or other damage due to frost penetration Soil backfill, insulation, heat, or other acceptable methods shall be used to protect soils during periods of the year in which frost penetration is possible

3 1 10 Trenching for Underground Utilities

3 1 10 1 General

3 1 10 1 1 All trench excavations shall be made by open cut to the lines and grades as shown on the drawings, within the tolerances specified, through whatever material is encountered

3 1 10 1 2 Trench excavations shall not advance more than 50 feet ahead of pipe laying and backfilling operations

3 1 10 1 3 All suitable material generated from excavation and trenching operations shall be used for backfilling as specified herein Material that is deemed unsuitable for backfill shall be disposed of by the Construction Subcontractor in the adjacent landfill

3 1 10 1 4 At the conclusion of each day's work, all trenches shall be either backfilled, barricaded, or adequately fenced and protected such that injuries to pedestrians, motorists, and wildlife would not be possible

3 1 10 1 5 Install Contractor-furnished utility warning tape 12 inches above any existing underground utilities exposed during the work

3 1 10 2 Trench Width

3 1 10 2 1 Trenches shall be excavated to the width necessary to permit the pipe to be laid and jointed properly and the backfill placed as specified

3 1 10 3 Trench Depth

3 1 10 3 1 When the excavation is in firm earth, care shall be taken to avoid excavation below the established grade

3 1 10 4 Trench Bottom

3 1 10 4 1 Protect and maintain when suitable natural materials are encountered Remove rock fragments and materials disturbed during excavation or raveled from trench walls

3 1 10 4 2 Unstable Trench Conditions When soft or otherwise unstable foundation material is encountered in the bottom of the trench, it shall be removed and replaced with fill material described in this specification A trench bottom that is wet will not be considered evidence that the trench bottom is unstable

3 2 Drainage

3 2 1 Excavation and site grading shall be performed in such a manner that the area of the site and the area immediately surrounding the site will be continually and effectively drained by gravity or by temporary pumps

3 2 2 Water shall not be permitted to accumulate in the excavation or adjacent to structure foundations

3 2 3 The excavation shall be drained by methods that will prevent wetting of the foundation bottom, undercutting of footings, or other conditions detrimental to proper construction procedures

3 2 4 The excavation shall be kept dry during digging, subgrade preparation, and continually thereafter until the structure to be built or installed is completed to the extent that all footings and foundation walls have been placed and foundation trenches are backfilled and no damage from hydrostatic pressure, flotation, or other causes will result

3 3 Clearing and Grubbing

Note Excavation occurs within wetland area Damage to wetlands shall be minimized by Subcontractor and shall be confined to "Extent of construction" zone as marked on plans

3 3 1 Clearing

3 3 1 1 Clearing shall consist of satisfactory disposal of vegetation designated for removal, including snags, brush, and rubbish occurring in the areas to be cleared and grubbed for the work

3 3 1 2 Roots, brush, and other vegetation in areas to be cleared for the work shall be cut off flush with or below the original ground surface

3 3 2 Grubbing

3 3 2 1 Grubbing shall consist of the removal and disposal of brush and matted roots from the areas required to be cleared and grubbed for the work

3 3 2 2 Material not suitable for foundation purposes shall be removed to a depth of not less than 18 inches below the original ground surface in areas designated as construction areas under the project, such as areas for buildings and areas to be paved

3 3 2 3 Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the required surface elevation for the work

3 3 3 Roots, brush, rotten wood, and other refuse from the clearing and grubbing operations shall be disposed of by the Construction Subcontractor in accordance with paragraph entitled "Disposal of Debris and Excess Material"

3 4 Overexcavation

3 4 1 All unstable materials encountered below the established elevation of the excavation that will not provide a firm foundation for subsequent work shall be removed and disposed of or placed in the landfill

3 4 2 Excavations performed below the depths indicated or required, unless directed by the Contractor, shall be returned to the proper elevation in accordance with the procedure specified herein for backfilling at no additional cost to the Contractor

3 4 3 Excavation under concrete vault and steel tank shall be 6 inches below specified bottom of structure or to weathered bedrock, whichever is lower If weathered bedrock is not encountered 3 feet below specified bottom of structure, excavation may terminate at that elevation upon approval of Contractor

3 5 Backfilling

3 5 1 Concrete vault and steel tank shall be set on a minimum of 6 inches of compacted strutural fill See Section 3 4 3 above regarding depth of excavation

3 5 2 All suitable material removed from excavations shall be used in the backfilling of the excavations prior to bringing in import suitable fill material No excavated material shall be wasted without approval of the Contractor

3 5 3 Prior to backfilling, clean excavations of all trash and debris, and compact the trench or excavation subgrade to the requirements indicated below in paragraph entitled "Compaction"

3 5 3 1 The existing grade or subgrade to receive fill shall be scarified to a minimum depth of 6 inches before the fill is started, such that the subgrade will be compacted (and moistened or dried, if necessary) to meet the density/moisture requirements indicated below

3 5 4 Backfilling shall not begin until construction below finish grade has been approved, unless otherwise noted herein

3 5 5 Fill shall be placed in horizontal layers not to exceed 10-inch compacted thickness and shall have a moisture content as specified herein such that the required degree of compaction may be obtained Each layer shall be compacted by hand or machine tampers or by other suitable equipment Compaction and testing requirements shall be in accordance with the requirements indicated below

3 5 6 Backfill around concrete vault and steel tanks shall occur in even lifts around the entire perimeter of the structure

3 5 7 If the Construction Subcontractor cannot attain the compaction densities required below using 10-inch-thick compacted lifts, then the Construction Subcontractor shall reduce the required compaction lift thickness to 6 inches This reduction in lift thickness shall be done at no additional cost to the Contractor

3 5 8 Placing Fill Material

3 5 8 1 Completed fill shall correspond to the proposed grades/elevations

3 5 8 2 Place fill materials in successive layers of loose materials not more than 13 inches deep to achieve the specified 10-inch maximum compacted lift thickness Note that if the compacted lift thickness must be reduced as described above, the loose layer thickness shall not exceed 8 inches

3 5 8 3 Uniformly spread each layer using approved devices and machinery

3 5 8 4 Fill materials shall be moistened (or dried) and thoroughly mixed as necessary to attain the moisture content indicated in paragraph entitled "Compaction "

3 5 8 5 Compact each layer of fill thoroughly using the appropriate compaction equipment Compact each layer to the requirements indicated below

3 5 8 6 Heavy equipment for spreading and compacting backfill shall not be operated closer to concrete vault or steel tank than a distance equal to the height of backfill above the bottom of the structure, the area remaining shall be compacted by power-driven hand/walk-behind tampers, compactors, or roller suitable for the material being compacted

3 5 8 7 Backfill shall be placed carefully around pipes to avoid damage to pipes

3 6 Compaction

3 6 1 All soil materials, including sand bedding and suitable fill material, shall be compacted and tested to the requirements indicated herein

3 6 2 Hydraulic compactors attached to the backhoe boom shall not be used to compact the pipe bedding, since this could damage the pipe Vibratory plate compactors or other suitable compaction equipment shall be used for the pipe bedding

3 6 3 Except as otherwise specified, moisture/density relationships shall be as determined by American Society for Testing and Materials (ASTM D1557) and the degree of field compaction shall be controlled with ASTM D1556 or ASTM D2922 and moisture content shall be controlled using ASTM D3017 All tests will be performed by the Subcontractor or the Subontractor's designated representative

3 6 3 1 Compaction of 90% of maximum density will be required for pipe bedding If pea gravel is used, quality control testing would not be required

3 6 3 2 Compaction of 90% of maximum density will be required under all structures, except as noted above for the pipe bedding

3 6 3 3 A minimum of one field compaction density/moisture test shall be required under each of the two tanks for each lift

3 6 4 Moisture Content

3 6 4 1 In areas where backfill is placed, the material, except as noted below, shall be moistened (or dried, if too wet) and thoroughly mixed to attain a moisture content between 2% below and 4% above optimum moisture when compacted

3 6 4 1 1 The sand used for pipe bedding shall be exempt from these moisture content range requirements, but should have a moisture content necessary to attain the indicated compaction density requirements

3 6 5 The Construction Subcontractor shall submit laboratory test results for the moisture/density relationships for the sand (pipe bedding), and import suitable fill material (if used) These will provide the maximum density and the optimum moisture content for the respective materials to be used in the work

3 6 6 The Contractor will pay for any test for soil compaction or moisture content that meets the requirements for the specifications The Construction Subcontractor shall pay for any soil tests that indicate the soil compaction and/or moisture content does not meet requirements of the specifications

3 7 Reconditioning of Subgrades

3 7 1 Approved compacted subgrades that are disturbed by the Construction Subcontractor's subsequent operations or adverse weather shall be scarified and compacted as specified herein to the required density and moisture limits prior to further construction thereon

3 7 2 Any rework due to the above actions shall be performed at no additional cost to the Contractor

3 8 Disposal of Debris and Excess Material

3 8 1 Rubble, debris, and material from trenching operations that is not suitable for fill shall be disposed of in the existing adjacent landfill

3 8 2 Excess material from excavation, unsuitable for or not required for backfilling, shall be wasted, spread, and leveled or graded as directed by the Contractor

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SECTION 02935 - RIPRAP

1 Part 1 General

1 1 Description

The work of this section consists of furnishing and placing stone riprap for the surface water diversion berm around the seep collection system

2 Part 2 Materials

2 1 Hand Laid Riprap

Shall be well-graded angular quarry stones, sound and hard, of durability to withstand exposure to water and weathering

2 2 Riprap Size

The design stone size is the d_{50} median stone diameter, which is defined as the stone size that 50% of the mixture by weight is larger than The median stone diameter, d_{50}, shall equal 4 inches unless otherwise specified on the plans Diameter of the largest stone shall be 1 5 times the design stone, d_{50}

2 3 Riprap Thickness

Riprap layer shall be a minimum of 1 5 times the d_{50} stone size

3 Part 3 Execution

3 1 Riprap Placement

Rocks shall be laid by hand Placing of rocks by dumping will not be permitted

Local surface irregularities of the slope protection shall not vary from the planned slope by more than one foot measured at right angles to the slope

SECTION 02970 - DRAIN ROCK, PVC LINER, AND FILTER FABRIC

1. Part 1 General

1 1 Description

The work under this section consists of furnishing and installing drain rock, PVC liner and filter fabric for the seep collection system

1 2 Submittals

In accordance with Section 01300 (see Contract Documents)

2 Part 2 Material

2 1 Drain Rock

A Source The source of drain rock shall be from an approved off-site borrow area

B Size and Permeability The drain rock shall be subangular to rounded washed gravel meeting the following gradation requirements

Sieve Size	% Passing
1 in	100
¾ in	80 - 100
3/8 in	10 - 30
No 4	0 - 4
No 40	0 - 1

C Testing Test frequency of drain rock shall conform to the following

Particle Size ASTM D 422	1 test for the drain rock used at the seep collection facility

2 2 PVC Liner

PVC liner shall be 40 mil thick PVC pipe boot shall be job constructed as described on the plans using 40 mil PVC and PVC adhesive designed for flexible liner or alternatively may be manufactured by vendor

2 3 Filter Fabric

Filter fabric shall be polypropylene nonwoven needle-punched fabric, 8 ounce weight

3 Part 3 Execution

3 1 Drain Rock Placement

A The drain rock shall be placed as shown on the drawings

B Dumping of material onto drainage pipe installations will not be permitted Spreading of material shall be done with care to minimize folds in the liner and to ensure that damage to drain pipe will not occur

C Drain rock materials may be placed in one continuous lift unless directed otherwise by the Contractor No compaction is required for the drain rock layer

3 2 PVC Liner Placement

PVC liner shall be installed as shown on the plans and in accordance with the manufacturer's instructions Seams shall be made with PVC adhesive for flexible PVC liner

3 3 Filter Fabric

Filter fabric shall be installed as shown on the plans and in accordance with manufacturer's instructions

SECTION 03100 - CONCRETE FORMWORK

1 Part 1 General

1 1 Section Includes

1 1 1 Formwork for cast-in-place concrete, with shoring, bracing, and anchorage

1 1 2 Openings for other work

1 1 3 Form accessories

1 1 4 Form stripping

1 2 References

1 2 1 ACI 347 - Recommended Practice for Concrete Formwork

1 2 2 PS-1 - Construction and Industrial Plywood

1 2 3 ACI 301 - Structural Concrete for Buildings

1 3 Design Requirements

1 3 1 Design, engineer, and construct formwork, shoring, and bracing to conform to ACI code requirements, resultant concrete to conform to required shape, line, and dimension

1 4 Quality Assurance

1 4 1 Perform work in accordance with ACI 347

1 5 Regulatory Requirements

1 5 1 Conform to applicable code for design, fabrication, erection, and removal of formwork

1 6 Coordination

1 6 1 Coordinate this section with other sections of work that require attachment of components to formwork

1 6 2 If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Contractor before proceeding

2 Part 2 Products

2 1 Wood Form Materials

2 1 1 Form Materials At the discretion of the Contractor

2 2 Prefabricated Forms

2 2 1 Preformed Steel Forms Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection, detrimental to tolerances and appearance of finished surfaces

2 2 2 Glass Fiber Fabric Reinforced Plastic Forms Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces

2 3 Formwork Accessories

2 3 1 Form Release Agent Colorless mineral oil that will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete

2 3 2 Corners Chamfered, wood strip type, ¾-by-¾-inch size, maximum possible lengths

2 3 3 Nails, Spikes, Lag Bolts, Through Bolts, Anchorages Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete

3 Part 3 Execution

3 1 Examination

3 1 1 Verify lines, levels, and centers before proceeding with formwork Ensure that dimensions agree with drawings

3 2 Earth Forms

3 2 1 Earth forms are not permitted

3 3 Erection - Formwork

3 3 1 Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301

3 3 2 Provide bracing to ensure stability of formwork Shore or strengthen formwork subject to overstressing by construction loads

3 3 3 Arrange and assemble formwork to permit dismantling and stripping Do not damage concrete during stripping Permit removal of remaining principal shores

3 3 4 Align joints and make watertight Keep form joints to a minimum

3 3 5 Obtain approval before framing openings in structural members that are not indicated on drawings

3 3 6 Provide chamfer strips on external corners of foundation walls

3 4 Application - Form Release Agent

3 4 1 Apply form release agent on formwork in accordance with manufacturer's recommendations

3 4 2 Apply prior to placement of reinforcing steel, anchoring devices, and embedded items

3 4 3 Do not apply form release agent where concrete surfaces will receive special finishes that are affected by agent Soak inside surfaces of untreated forms with clean water Keep surfaces coated prior to placement of concrete

3 5 Inserts, Embedded Parts, and Openings

3 5 1 Provide formed openings where required for items to be embedded in or passing through concrete work

3 5 2 Locate and set in place items that will be cast directly into concrete

3 5 3 Coordinate work of other sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts

3 5 4 Install accessories in accordance with manufacturer's instructions, straight, level, and plumb Ensure items are not disturbed during concrete placement

3 5 5 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection Locate openings at bottom of forms to allow flushing water to drain

3 5 6 Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces

3 6 Form Cleaning

3 6 1 Clean and remove foreign matter within forms as erection proceeds

3 6 2 Clean formed cavities of debris prior to placing concrete

3 6 3 Flush with water or use compressed air to remove remaining foreign matter Ensure that water and debris drain to exterior through clean-out ports

3 6 4 During cold weather, remove ice and snow from within forms Do not use de-icing salts or water to clean out forms, unless formwork and concrete construction proceed within heat enclosure Use compressed air or other means to remove foreign matter

3 7 Formwork Tolerances

3 7 1 Construct formwork to maintain tolerances required by ACI 301

3 8 Field Quality Control

3 8 1 Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties and items are secure

3 8 2 Do not reuse wood formwork more than four times for concrete surfaces to be exposed to view Do not patch formwork

3 9 Form Removal

3 9 1 Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads

3 9 2 Loosen forms carefully Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view

3 9 3 Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged Discard damaged forms

SECTION 03300 - CAST-IN-PLACE CONCRETE

1 Part 1 General

1 1 Section Includes

1 1 1 Floors and slabs on grade

1 1 2 Control and expansion and contraction joint devices associated with concrete work, including joint sealants

1 1 3 Equipment pads

1 2 References

1 2 1 ACI 301 - Structural Concrete for Buildings

1 2 2 ACI 302 - Guide for Concrete Floor and Slab Construction

1 2 3 ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete

1 2 4 ACI 305R - Hot Weather Concreting

1 2 5 ACI 306R - Cold Weather Concreting

1 2 6 ACI 308 - Standard Practice for Curing Concrete

1 2 7 ACI 318 - Building Code Requirements for Reinforced Concrete

1 2 8 ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type)

1 2 9 ANSI/ASTM D1190 - Concrete Joint Sealer Hot-Poured Elastic Type

1 2 10 ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

1 2 11 ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1 2 12 ASTM C33 - Concrete Aggregates

1 2 13 ASTM C94 - Ready-Mixed Concrete

1 2 14 ASTM C150 - Portland Cement

1 2 15 ASTM C260 - Air Entraining Admixtures for Concrete

1 2 16 ASTM C494 - Chemicals Admixtures for Concrete

1 3 Submittals

1 3 1 Submit under provisions of Section 01300 (See Contract Documents)

1 3 2 Product Data Provide data on joint devices, attachment accessories, admixtures

1 3 3 Samples Submit two-inch-long samples of expansion/contraction joint and control joint

1 3 4 Manufacturer's Installation Instructions Indicate installation procedures and interface required with adjacent work

1 4 Project Record Documents

1 4 1 Submit under provisions of Section 01300

1 4 2 Accurately record actual locations of embedded utilities and components that are concealed from view

1 5 Quality Assurance

1 5 1 Perform work in accordance with ACI 301

1 5 2 Conform to ACI 305R when concreting during hot weather

1 5 3 Conform to ACI 306R when concreting during cold weather

1 6 Coordination

1 6 1 Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories

2 Part 2 Products

2 1 Concrete Materials

2 1 1 Cement Rocky Flats, Type II modified or Type V

2 1 2 Fine and Coarse Aggregates ASTM C33

2 1 3 Water Clean and not detrimental to concrete

2 2 Admixtures

2 2 1 Air Entrainment ASTM C260

2 2 2 Chemical ASTM C494, Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating

2 3 Accessories

2 3 1 Non-Shrink Grout Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days

2 4 Joint Devices and Filler Materials

2 4 1 Joint Filler ASTM D1751, ASTM D994, Asphalt impregnated fiberboard or felt, ¼-inch thick, tongue and groove profile

2 4 2 Construction Joint Devices Integral galvanized steel 1½-inch thick, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge

2 4 3 Sealant and Primer Polyurethane type

2 5 Concrete Mix

2 5 1 Mix concrete in accordance with ACI 304 Deliver concrete in accordance with ASTM C94

2 5 2 Select proportions for normal weight concrete in accordance with ACI 301 Method 1

2 5 3 Provide concrete to the following criteria

2 5 3 1 Compressive Strength (28 days) 3,000 psi for slab on grade

2 5 3 2 Slump 1 to 3 inches

2 5 3 3 Maximum Water/Cement Ratio 0 5

2 5 3 4 Entrained Air 5% ± 1%

2 5 4 Use accelerating admixtures in cold weather only when approved by Contractor Use of admixtures will not relax cold weather placement requirements

2 5 5 Use calcium chloride only when approved by Contractor

2 5 6 Use set retarding admixtures during hot weather only when approved by Contractor

2 5 7 Add air entraining agent to normal weight concrete mix for work exposed to exterior

3 Part 3 Execution

3 1 Examination

3 1 1 Verify requirements for concrete cover over reinforcement

3 1 2 Verify that anchors, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete

3 2 Preparation

3 2 1 Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions

3 2 2 In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout

3 3 Placing Concrete

3 3 1 Place concrete in accordance with ACI 304, ACI 301, and ACI 318

3 3 2 Place concrete in forms within 90 minutes of beginning mixing

3 3 3 Notify Contractor minimum 24 hours prior to commencement of operations

3 3 4 Ensure reinforcement, inserts, embedded parts, formed joint fillers, and joint devices are not disturbed during concrete placement

3 3 5 Install joint fillers, in accordance with manufacturer's instructions

3 3 6 Separate slabs on grade from vertical surfaces with ½ inch thick joint filler

3 3 7 Extent joint filler from bottom of slab to within ½ inch of finished slab surface

3 3 8 Install joint devices in accordance with manufacturer's instructions

3 3 9 Install construction joint device in coordination with floor slab pattern placement sequence Set top to required elevations Secure to resist movement by wet concrete

3 3 10 Install joint device anchors Maintain correct position to allow joint cover flush with floor and wall finish

3 3 11 Install joint covers in longest practical length when adjacent construction activity is complete

3 3 12 Maintain records of concrete placement Record date location quantity air temperature and test samples taken

3 3 13 Place concrete continuously between predetermined expansion, control, and construction joints

3 3 14 Do not interrupt successive placement, do not permit cold joints to occur

3 3 15 Place floor slabs in checkerboard pattern indicated

3 3 16 Saw cut joints within 24 hours after placing Using 3/16-inch-thick blade, cut into ¼ depth of slab thickness

3 3 17 Screed slabs on grade level, maintaining surface flatness of maximum ¼ inch in 10 feet

3 4 Concrete Finishing

3 4 1 Provide formed concrete surfaces to be left exposed with smooth rubbed finish

3 4 2 Steel trowel all floor surfaces

3 4 3 In areas with floor drains, maintain floor elevation at walls, pitch surfaces uniformly to drains as indicated on drawings

3 5 Curing and Protection

3 5 1 Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury

3 5 2 Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete

3 5 3 Ponding Maintain 100 percent coverage of water over floor slab areas continuously for 4 days

3 5 4 Spraying Spray water over floor slab areas and maintain wet for 7 days

3 6 Field Quality Control

3 6 1 Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400

3 6 2 Provide free access to work and cooperate with appointed firm

3 6 3 Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of work

3 6 4 Tests of cement and aggregates may be performed to ensure conformance with specified requirements

3 6 5 Three concrete test cylinders will be taken for every 75 or less cu yds of each class of concrete placed

3 6 6 One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions a concrete it represents

3 6 7 One slump test will be taken for each set of test cylinders taken In addition, slump tests shall be taken if the consistency of the concrete appears to vary

3 7 Patching

3 7 1 Allow Contractor to inspect concrete surfaces immediately upon removal of forms

3 7 2 Excessive honeycomb or embedded debris in concrete is not acceptable Notify Contractor upon discovery

3 7 3 Patch imperfections in accordance with ACI 301

3 8 Defective Concrete

3 8 1 Defective Concrete Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements

3 8 2 Repair or replacement of defective concrete will be determined by the Contractor

3 8 3 Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Contractor for each individual area

SECTION 03400 - PRECAST CONCRETE

1 Part 1 General

1 1 1 Precast Concrete Vault and Precast Concrete Vault Joint

1 2 References

1 2 1 ASTM A615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

1 2 2 ASTM C33, Concrete Aggregates

1 2 3 ASTM C39, Test Method for Compressive Strength of Cylindrical Concrete Specimens

1 2 4 ASTM C136, Method for Sieve Analysis for Fine and Coarse Aggregates

1 2 5 ASTM C143, Test Method for Sump of Portland Cement Concrete

1 2 6 ASTM C150, Specification for Portland Cement

1 2 7 ASTM C192, Method of Making and Curing Concrete Test Specimens in the Laboratory

1 2 8 ASTM C231, Test Method of Air Content of Freshly Mixed Concrete by the Pressure Method

1 2 9 ASTM C260, Specification for Air Entraining Admixtures for Concrete

1 2 10 ASTM C494, Specification for Chemicals Admixtures for Concrete

1 2 11 ASTM C857, Recommended Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

1 2 12 ASTM C858, Specification for Underground Precast Concrete Utility Structures

1 2 13 ASTM 318-89, Specification for Design of Concrete using Ultimate Strength Methods

1 3 Submittals

1 3 1 Manufacturer shall submit shop drawings and receive Contractor approval prior to manufacture of tank

1 3 2 Manufacturer shall coordinate the number, size, and location of all penetrations during the submittal process

1 3 3 Submit under provisions of Section 01300 (see Contract Documents)

1 3 4 Product Data Provide data on joint devices and admixtures

1 3 5 Samples Submit two inch long samples of joint material

1 3 6 Manufacturer's Installation Instructions Indicate installation procedures and interface required with adjacent work

1 4 Project Record Documents

1 4 1 Submit under provisions of Section 01300 (see Contract Documents)

1 5 Quality Assurance

1 5 1 Precast concrete to be manufactured in accordance with ASTM C858

1 5 2 Precast concrete components to be installed in accordance with Manufacturer's Installation Instructions

2 Part 2 Products

2 1 Loadings Used for Structural Design of Precast Concrete

2 1 1 Soil Compacted Dry Unit Weight - 105 pcf

2 1 2 Equivalent Fluid Pressure (active soil pressure) - 52 pcf

2 1 3 Maximum Surcharge Loading - 100 psf

2 1 4 Soil Cover minimum = 0 ft maximum = 2 ft

2 2 Concrete Materials

2 2 1 Portland Cement ASTM C150 Type II modified or Type V

2 2 2 Fine and Coarse Aggregates ASTM C33

2 2 3 Water Clean and not detrimental to concrete

2 3 Admixtures

2 3 1 Air Entrainment ASTM C260

2 3 2 Chemical ASTM C494, Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating

2 4 Reinforcement

2 4 1 Rebar ASTM A615 grade 60

2 5 Concrete Mix

2 5 1 Provide concrete to the following criteria

2 5 1 1 Compressive Strength (28 days) 4,500 psi

2 5 1 2 Slump 1 to 3 inches

2 5 1 3 Maximum Water/Cement Ratio 0 5

2 5 1 4 Entrained Air 5% ± 1%

2 5 2 Admixtures will include air-entraining agent, water-reducing agent, and accelerator

2 6 Joint Materials

2 6 1 Joint Gasket Conseal CS-102 or equivalent

2 7 Accessories

2 7 1 Grade rings shall be precast concrete

2 7 2 Manhole ring and cover shall be cast-iron

2 7 3 Penetrations shall be sealed with Link-Seal gaskets, Model C, manufactured by Thunderline Corporation, or approved equal

3. Part 3 Execution

3 1 Preparation

3 1 1 Prepare excavation in accordance with Section 02200, Earthwork

3 2 Installation of Precast Concrete

3 2 1 Install precast concrete in accordance with manufacturer's instructions

3 2 2 Install joint gasket in accordance with manufacturer's instructions

3 2 3 Install precast grade rings and watertight ring and cover in accordance with manufacturer's instructions

3 3 Field Quality Control

3 3 1 Contractor or Contractor's representative will be notified of placement of precast concrete structure 24 hours in advance

3 4 Patching

3 4 1 Excessive honeycomb or embedded debris in concrete is not acceptable Notify Contractor upon discovery (before installation)

3 4 2 Patch imperfections in accordance with ACI 301 or require replacement of precast concrete

3 5 Defective Concrete

3 5 1 Defective Concrete Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements

3 5 2 Repair or replacement of defective concrete will be determined by the Contractor

3 5 3 Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Contractor for each area

SECTION 05500 - METAL FABRICATIONS

1 Part 1 General

1 1 Section Includes

1 1 1 Fabricated ferrous metal items

1 2 References

1 2 1 ASTM A36 - Structural Steel

1 2 2 ASTM A53 - Hot-Dipped, Zinc-Coated Welded and Seamless Steel Pipe

1 2 3 ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip

1 2 4 ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware

1 2 5 ASTM A283 - Carbon Steel Plates, Shapes, and Bars

1 2 6 ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners

1 2 7 ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products

1 2 8 AWS A2 0 - Standard Welding Symbols

1 2 9 AWS D1 1 - Structural Welding Code

1 2 10 SSPC - Steel Structures Painting Council

1 2 11 ASTM A-603 Wire Rope

1 3 Submittals

1 3 1 Submit under provisions of Section 01300 (See Contract Document)

1 3 2 Submit welder qualifications

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1 3 3 Shop Drawings Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories Include erection drawings, elevations, and details

1 3 4 Indicate welded connections using standard AWS A2 0 welding symbols Indicate net weld lengths

1 3 5 Submit qualified weld procedures

1 3 6 Submit qualified weld tests and inspection reports

1 4 Field Measurements

1 4 1 Verify that field measurements are as indicated on shop drawings

1 5 Quality Assurance

1 5 1 Provide welder qualifications and perform welding, tests, and inspections in accordance with AWS structural welding code, AWS D1 1, Latest Edition

2 Part 2 Products

2 1 Materials

2 1 1 Steel Sections ASTM A36

2 1 2 Pipe ASTM A53, Grade B Schedule 40

2 1 3 Bolts, Nuts, and Washers ASTM A307

2 1 4 Welding Materials AWS D1 1, type required for materials being welded

2 1 5 Shop and Touch-Up Primer SSPC 15, Type 1, red oxide

2 1 6 Steel Wire Rope, Galvanized

2 2 Fabrication

2 2 1 Fit and shop assemble in largest practical sections for delivery to site

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2 2 2 Fabricate items with joints tightly fitted and secured

2 2 3 Continuously seal joined members by continuous welds

2 2 4 Grind exposed joints flush and smooth with adjacent finish surface Make exposed joints butt tight, flush, and hairline Ease exposed edges to small uniform radius

2 2 5 Exposed Mechanical Fastenings Flush countersunk screws or bolts, unobtrusively located, consistent with design of component, except where specifically noted otherwise

2 2 6 Supply components required for anchorage of fabrications Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise

2 3 Finishes

2 3 1 Prepare surfaces to be primed in accordance with SSPC SP2

2 3 2 Do not prime surfaces in direct contact with concrete or where field welding is required

2 3 3 Prime paint items with one coat

3 Part 3 Execution

3 1 Examination

3 1 1 Verify that field conditions are acceptable and are ready to receive work

3 1 2 Beginning of installation means erector accepts existing conditions

3 2 Preparation

3 2 1 Clean and strip primed steel items to bare metal where site welding is required

3 2 2 Supply items required to be cast into concrete with setting templates, to appropriate sections

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3 3 Installation

3 3 1 Install items plumb and level, accurately fitted, free from distortion or defects

3 3 2 Allow for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments

3 3 3 Field weld components indicated on drawings

3 3 4 Perform field welding in accordance with AWS D1 1

3 3 5 Obtain Contractor's approval prior to site cutting or making adjustments not scheduled

3 3 6 After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete

3 4 Erection Tolerances

3 4 1 Maximum Variation From Plumb ¼ inch non-cumulative

3 4 2 Maximum Offset From True Alignment ¼ inch

SECTION 09900 - PAINTING

1 Part 1 General

1 1 Related Work Specified Elsewhere

1 1 1 Section 05500, Structural and Miscellaneous Steel

1 2 Quality Assurance

1 2 1 Include on label of containers

- Manufacturer's name
- Type of paint
- Manufacturer's stock number
- Color
- Instructions for application
- Paint analysis

1 3 Submittals

1 3 1 Submit proposed paint and color schedule for approval, including for each item

- Surface to be painted
- Type of paint
- Special thinners required, if any
- Color
- Special surface preparation required
- Material Safety Data Sheet (MSDS)

1 4 Products Delivery and Storage

1 4 1 Delivery of Materials -- Except for locally mixed custom colors, deliver materials in sealed containers with labels intact and legible

1 4 2 Storage of Materials

1 4 2 1 The Subcontractor shall provide storage facilities adequate to protect the paint materials and equipment from inclement weather The storage facilities shall have adequate ventilation During cold weather, the storage facilities shall be

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heated to not less than the minimum recommended by the paint products manufacturer and at no time shall the temperature be below 35°F

1 4 2 2 At the end of each work day, all paint materials shall be removed from the work area and properly stored

1 5 Job Conditions

1 5 1 Environmental Conditions

1 5 1 1 Comply with manufacturer's recommendations for environmental conditions under which coatings and coating systems can be applied

1 5 1 2 Do not apply finish in areas where dust is being generated

1 5 1 3 Provide adequate ventilation when using flammable or toxic paint materials

1 5 2 Protection

1 5 2 1 Cover or otherwise protect surfaces not being painted

1 5 2 2 Furnish fire-retardant protective coverings Do not use flammable material for protective coverings unless special permission is obtained from the Buyer

2 Part 2 - Products

2 1 Materials

2 1 1 Materials selected for painting systems for each type of surface shall be the products of a single manufacturer

2 1 2 Other products not specified, but required for the job, shall be commercial products designed for the intended use

3. Part 3 - Execution

3 1 Inspection

3 1 1 Examine surfaces scheduled to receive paint for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work.

3 2 Preparation of Surfaces

3 2 1 Ferrous Metal Surfaces

3 2 1 1 Prepare surface in accordance with SSPC-SP2, Hand Tool Cleaning

3 2 1 2 Feather edges of sand paint

3 2 2 Galvanized Metal - Clean surface in accordance with SSPC-SP2, Solvent Cleaning Dry with clean lint-free cloth

3 2 3 Aluminum - Clean surface in accordance with SSPC-SP1, Solvent Cleaning Dry with clean lint-free cloth

3 3 Application

3 3 1 Apply paint with suitable brushes, rollers, or spraying equipment

3 3 1 1 Do not exceed rate of application recommended by paint manufacturer for type of surface Keep brushes, rollers, and spraying equipment clean, dry, and free from contaminants

3 3 2 Comply with recommendation of product manufacturer for drying time between succeeding coats

3 3 3 Vary slightly the color of successive coats Tinting shall be uniform

3 3 4 Sand dust between each coat to remove defects visible from a distance

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3 3 5 Finish coats shall be smooth, free of brush marks, streaks, laps or pileup of paints, and skipped or missed areas Finished metal surfaces shall be free of skips, voids, or pinholes in any coat when tested with a low voltage Doors, frames, and finished metalwork or woodwork shall be painted by brush or spray only Do not roll

3 3 6 Inspection

3 3 6 1 Do not apply successive coats until each completed coat has been inspected and approved by Contractor

3 3 6 2 Only inspected coats of paint will be considered in determining the number of coats Defective or improper previous coatings shall be removed or corrected to the satisfaction of the Contractor

3 3 7 Make edges of paint adjoining other materials or colors clean and sharp with no overlapping

3 4 Cleaning

3 4 1 Touch up and restore finish where damaged

3 4 2 Remove spilled, splashed, or splattered paint from all surfaces

3 4 3 Do not mar surface finish of item being cleaned

3 5 Painting Systems and Schedules

3 5 1 Painting Systems

3 5 1 1 Paint System One (PS-One) for interior-exterior metals

3 5 1 1 1 Prime coat for touch up Oil-base, rush-inhibitive metal primer

3 5 1 1 2 Finish - Solvent-type Alkyd enamel, two coats

3 5 2 Paint Schedules (all colors will be selected by the Contractor when not specified)

3 5 3 Items Not Required to be Painted

3 5 3 1 Exterior galvanized metals

SECTION 13200 - PASSIVE TREATMENT TANK

1 Part 1 General

11 Summary

111 Scope of Work

1111 Items specified in this section apply to the seep treatment system

1112 Furnish and install the following as shown on the drawings to ensure a complete and operable system

112 Related Sections

1121 Section 13210 - Filters, Disposable Drum Filters, Chemical Storage Drums

1122 Section 13215 - Piping

12 References

The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by the basic designation only

121 ASTM A36, Structural Steel

122 ASTM A283, Carbon Steel Plates, Shapes, and Bars

123 ASTM A307, Carbon Steel Externally Threaded Standard Fasteners

124 AWS A2 0, Standard Welding Symbols

125 AWS D1 1, Structural Welding Code

126 SSPC, Steel Structures Painting Council

127 ANSI B1 20 1, Pipe Threads, General Purpose (Inch)

128 ANSI B16 5, Pipe Flanges and Flanged Fittings

1 3 Submittals

The following shall be submitted to the Contractor for approval

1 3 1 Detailed tank plans showing location of all tank fittings with material takeoffs will be submitted prior to procurement Design calculations and detailed construction drawings demonstrating compliance with this Section prior to procurement As-built record drawings will be submitted and approved by Contractor at control closeout

1 3 2 Copies of all laboratory and field test reports within 24 hours of the completion of the test

1 4 Qualifications

1 4 1 The tank manufacturer shall have been regularly engaged in the design and manufacture of steel tanks such as specified herein for at least seven (7) years The tank manufacturer's experience will include at least fifteen (15) tank installations of equal or larger capacity than specified herein

1 4 2 The tank shall be warranted for two (2) years to be free of defects in material and workmanship

1 5 Delivery, Storage, and Handling

1 5 1 Deliver, store, protect, and handle tanks in an orderly manner

1 5 2 Prior to shipment, place temporary caps and closures on all tank openings Maintain in place until installation

2 Part 2 Products

2 1 General

2 1 1 Service Secondary containment for reactor vessels

2 1 2 Fluid pH 4 0 - 9 0

213 Installation Outdoors, min ambient temp of -20°F, max ambient temp of 120°F Placed below grade with top of tank flush with ground surface Top of tank will be exposed to ultraviolet (UV) rays

214 Capacity 4,000 gallons and have an outside diameter of 10 feet and height of 7 feet, 2 inches

215 Type Vertical, flat bottom

216 Design Pressure Burial to top of tank (7 foot depth) plus one foot overburden on the top of tank Design soil pressures are as follows active lateral earth pressure (compacted silt) = 52 pcf, surcharge = 100 psf, soil compacted dry unit weight = 105 pcf, soil compacted wet unit weight = 120 pcf

217 Nameplate Each major component shall have a nameplate to list the manufacturer's name, address, component type or style, model or serial number, and catalog number on a plate secured to the equipment Plates shall be durable and legible throughout equipment life and made of stainless steel Plates shall be fixed to tank hatch with nonferrous screws or bolts

2.2 Tank Design and Materials of Construction

221 Tank manufacturer shall include the following

- Tank itself, 10' diameter x 7'-2" high
- Flange extending 12" beyond bottom of tank with (10) 1/4" x 3" x 27" stiffeners
- 18" high x 4'-0" x 4'-9" manway
- 4'-1" x 4'-10" hatch with hinges, handle to pull open, and hasp
- Three lifting lugs attached to top of tank
- Insulation, blown on, 2" thick, on hatch cover, in manway, on inside top of tank, and 1' down sides of tank
- Steel ladder welded in
- One sump, 12" x 12" x 4"
- Bracket for attaching flow transmitter (Cross-section C)

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- Bracket for filters (detail 8) (not attached to tank)
- (1) 5" pipe penetration
- (1) 4" pipe penetration
- (2) 3" FPTs in top of tank (one for vent and one for leak detection)
- (1) 3/4" FPT in top of tank for conduit

2.2.2 Steel Tank shall be fabricated of A-36 carbon steel, sandblasted, and coal tar epoxy coated The tank shall be designed to withstand soil pressure as stated above The tank shall be 10 foot diameter with 12 foot bottom flange to prevent vertical uplift as shown on plans Initial calculations indicate that bottom and side walls will be 1/4" steel and top will be 5/16" steel with (2) 2" x 2" x 1/4" angle brackets welded to top

2.2.3 Welds

Bottom to sidewall

1/4" fillet weld each side

Top to sidewall

Inside 1/4" fillet weld, outside corner modified 1/4" butt weld

All other

Full penetration 1/4" butt weld welded one-half way from each side

2.2.4 Tank Connections Piping, vent, or instrument connections to the tank shall be welded unless noted on the plans as threaded

2.2.5 Link-Seal Gaskets Where noted on plans, penetration shall be sealed with Link-Seal gaskets, Model C, manufactured by Thunderline Corporation, or approved equal

2.2.6 Support bracket tank manufacturer shall supply steel support bracket for filters as shown in Detail 8

2.2.7 Ladder shall be supplied and welded in place by tank manufacturer

2.2.8 2" thick polyurethane insulation shall be spray applied to inside of tank hatch, inside top of tank, and one foot down inside walls from top

3 Part 3 Execution

3.1 Examination

3.1.1 Prior to tank installation, verify that grade surface has been properly prepared

3.1.2 Verify that all tank openings are properly located as fabricated

3.2 Installation

3.2.1 Install tanks in accordance with manufacturer's instructions

3.2.2 Tanks shall be installed in as level a condition as possible, not to exceed _-inch slope as measured across the entire tank width

3.2.3 Upon completion of installation, a visual inspection of all penetrations shall be performed

SECTION 13210 - FILTERS, DISPOSABLE DRUM FILTERS, AND CHEMICAL STORAGE DRUMS

1 Part I General

1 1 Description

1 1 1 Items specified in this section apply to the passive seep collection and treatment system

1 2 Related Sections

1 2 1 Section 13215 - Piping

1 3 Submittals

The following shall be submitted by the Construction Subcontractor to the Contractor for approval

1 3 1 Spare Parts Data The Construction Subcontractor shall furnish spare parts data for each different item of materials and equipment specified The data shall include a complete list of parts and supplies, with current unit prices and source of supply

1 3 2 Operating and Maintenance Instructions Operating instructions outlining the step-by-step procedures required for system start-up and operation shall be furnished The instruction shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features

1 4 General Requirements

1 4 1 Standard Products Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use at least 2 years prior to bid opening

1 4 2 Verification of Dimensions The Construction Subcontractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contractor of any discrepancy before performing the work

1 5 Qualifications

1 5 1 Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience Documentation shall be made available to the Contractor upon request

1 6 Delivery and Storage

1 6 1 All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants

2 Part 2 Products

2 1 Filters

2 1 1 Filters shall be bag filters capable of holding 10 micron or 20 micron bags Two filters shall be mounted in parallel to minimize head loss and maximize time between filter changeout

2 1 2 Filter housings shall be stainless steel with 2-inch female pipe thread (FPT) inlet and outlet ports

Bag filter shall be Rosedale 82-30-2P-2-150-N-S-D-B-S-B

Where

- 82 = Model 82
- 30 = 30-inch housing
- 2P = 2-inch FPT inlet and outlet
- 2 = side outlet
- 150 = 150 psi
- N = No ASME code stamp
- S = 304 stainless steel
- D = displacer
- B = Buna N cover gasket
- S = basket seal (required)
- B = filter bag basket (filter bags shall be 10 micron or 20 micron)

2 2 Granular Activated Carbon (GAC) Disposable Drum Filters

2 2 1 Disposable drum filters (three) shall be 55-gallon size and constructed of steel The drum filters shall be rated for a working pressure of 12 psi and a maximum flow rate of 10 gpm Inlet and outlet connections shall be 2" FPT Activated carbon shall be bituminous coal carbon, 8 x 30 mesh Drums shall be Northwestern Carbon L-180 or Contractor approved equal

2 2 2 Drum filter accessories to be supplied include the following (1) three drum dollies, Wagner Model 4000 or equivalent, and (2) Wesco vertical drum lifter, Wesco Manufacturing Model DL-1 or equivalent

2 3 Chemical Storage Drums

2 3 1 Chemical storage drums are to be polypropylene and 65-gallon size Drum setup shall include a stand with spill containment Drum to be ProTreat Technology Corporation drum or an approved equal

2 3 2 Chemical storage drum shall have 3-inch glass tube type purge meter with 1/4-inch NPT fittings Meter shall be Wallace & Tiernan Model C033 or approved equal Tube from flow meter to 3-inch PVC collector pipe shall be 1/4-inch Teflon or Contractor approved equal

3 Part 3 Execution

3 1 Equipment Installation

3 1 1 Filters, disposable drum filters, and chemical storage drums shall be installed in the position indicated and in accordance with the manufacturer's written instructions All appurtenances required for a complete and operating system shall be provided, including such items as piping, conduit, valves, fittings, and controls

3 2 Field Testing and Adjusting Equipment

3 2 1 Operations Test Prior to acceptance, an operational test of all systems shall be performed to determine whether the installed equipment meets the purpose and intent of the specifications Tests shall demonstrate that the equipment is not electrically,

mechanically, structurally, or otherwise defective, is in safe and satisfactory operating condition, and conforms with the specified operating characteristics Tests shall include checks for leaks in all piping and seals, correct operation of control systems and equipment, and proper alignment.

3 2 2 Retesting If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted at Subcontractor's expense

SECTION 13215 - PIPING

1. Part 1 General

1 1 Summary

1 1 1 Scope of Work

1 1 1 1 Items specified in this section apply to the passive seep collection and treatment facility

1 1 1 2 Furnish and install the following as shown on the drawings to ensure a complete and operable system double contained polypropylene piping, PVC piping

1 1 1 3 All piping shall be in compliance with RFETS SP-220

1 1 2 Related Sections

1 1 2 1 Section 02200 - Earthwork

1 2 References

1 2 1 SP-220, Rev J, Rocky Flats Plant Standard for Piping Material Specifications

1 2 2 SP-301, Rev J, Rocky Flats Plant Standard for Pipe Systems Testing Procedure

1 2 3 ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

1 2 4 ASTM D2464, Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

1 2 5 ASTM D2467, Socket-type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

1 2 6 ASTM A307, Specification for Carbon Steel Externally Threaded Standard Fasteners

1 2 7 ASTM D2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

1 2 8 1-50000-ADM-04 01, Rocky Flats Plant Verification and Testing Procedure

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1 2 9 ASTM D2855, Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

1 2 10 ASTM F656, Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

1 2 11 ASTM D4101, Black UV Stabilized Block Co-polymer Polypropylene Pipe

1 2 12 ASTM D2657, Butt Welding Polyolefin pipe

1 2 13 Environment Management QAPjP, Sitewide Quality Assurance Project Plan

1 3 Submittals

The following shall be submitted by the Construction Subcontractor to the Contractor for approval

1 3 1 Piping Plan and Elevation Drawings Provide for approval dimensioned plan and elevation drawings indicating lengths, sizes, and routing of piping Include sections as required

1 3 2 Product Data Provide data on pipe materials, pipe fittings, valves, and accessories Provide manufacturer's catalog information, including installation instructions

1 3 3 Pressure Testing Log Provide pressure test record for each piping system, including the following minimum information line designation number, date of test, type of test, pressure applied, length of time at test pressure, tested by, and any comments

1 4 Qualifications

1 4 1 Installer Company specializing in performing the work of this section with a minimum of three years of documented experience Documentation shall be made available to the Contractor upon request

1 5 Delivery and Storage

1 5 1 Deliver, store, protect, and handle products in an orderly manner

1 5 2 Accept valves on site in shipping containers with labeling in place Inspect for damage

1 5 3 Provide temporary end caps and closures on piping and fittings Maintain in place until installation

1 5 4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system

1 6 Environmental Requirements

1 6 1 Do not install underground piping when bedding is saturated or frozen

2 Part 2 Products

2 1 Double Contained Polypropylene Piping

Double Contained Polypropylene Piping shall meet SP-220 specification PR

2 1 1 Piping 2 inch through 4 inch Black, ASTM D-4101

2 1 2 Fittings All sizes Molded butt fusion, ASTM D-2657, 2 inch through 4 inch

2 1 3 Joining Method All double contained polypropylene pipe and fittings shall be joined using thermal butt fusion methods as recommended by pipe manufacturer

2 2 PVC Process Piping

PVC piping shall meet SP-220 specification PA

2 2 1 Piping

2 2 1 1 ½ inch through 10 inch Schedule 80, PVC, Class 12454-B, threaded or plain ends, in accordance with ASTM D-1785 (only Schedule 80 pipe may be threaded) All piping shall be Schedule 80

2 2 2 Fittings

2 2 2 1 ½ inch through 2 inch Type 1, Grade 1, PVC, Class 12454-B, Schedule 80, screwed or socket Fitting grade to match pipe grade

2 2 2 2 3 inch and larger Type 1, Grade 1, PVC, Class 12454-B, Schedule 80 socket Fitting grade to match pipe grade

2 2 3 Flanges

2 2 3 1 ½ inch and larger Type 1, Grade 1, Class 150, flat face, PVC, Schedule 80, socket

2 2 4 Unions

2 2 4 1 ½ inch through 2 inch Type 1, Grade 1, PVC, Schedule 80, socket or screwed

2 2 4 2 Larger than 2 inch Type 1, Grade 1, PVC, Schedule 80, socket

2 2 5 Bolting - All Sizes Stud bolt, stainless steel, ASTM A193, Gr B8, Class 1, nuts, heavy hex, stainless steel ASTM A194, Gr 8, washers, ANSI B 18 22 1 Type B, Narrow Series, 304 stainless steel

2 2 6 Gaskets - All sizes 1/8-inch neoprene, full face, 50 - 70 durometer A, Class 150

2 2 7 Cement for Socket Joints - PVC solvent cement in accordance with ASTM D2564 and D2855 and as recommended by the manufacturer of the pipe and fittings

2 2 8 Primer - Primer as recommended by the manufacturer of the pipe and pipe fittings

2 2 9 Valves

2 2 9 1 Ball Valves in accordance with SP-220, valve specification sheet V1021 with the following exception

Operator	Below grade valve - cross or other remote operator; supply four-foot long key Valve in treatment tank - Lever

2 3 Flexible PVC Hose and Quick Disconnect Cam Operating Couplings

2 3 1 Flexible PVC hose shall be Kanaflex PVC suction and discharge hose Series 100 Standard Duty, 2 inch or Contractor approved equal

2 3 2 Quick disconnect cam operating couplings shall be black glass filled polypropylene with EPT gaskets, rated to 100 psi, or Contractor-approved equal

2 3 3 Hose clamps for flexible PVC hose shall be Kanaflex "Power Lock" clamps, Harrington part number PLCP-020KF or Contractor-approved equal

3 Part 3 Execution

3 1 General

3 1 1 The Construction Subcontractor shall furnish all tools equipment, materials, and supplies and perform all labor required for furnishing the installation, testing, and flushing of all piping and appurtenances as shown on the drawings and specified herein

3 1 2 The work of this section shall include the furnishing, installation and testing of pipe, pipe supports, fittings, specials, and all required appurtenances as shown on the drawings and as required to make the entire piping system operable within the treatment system

3 1 3 All pipes, fittings, couplings, and appurtenant items shall be new, free from defects of contamination, and wherever possible, be the standard product of the manufacturer They shall be furnished in pressure or thickness classes as specified or shown

3 1 4 The different kinds of buried piping shall be installed in accordance with the drawings, procedures, and methods contained within this specification Such procedures and methods shall conform to or exceed the minimum requirements of the pipe manufacturer and shall be as supplemented by the provisions specified herein The interior of the pipe, fittings, and couplings shall be clean and free from contamination when installed Effective means shall be taken to prevent the entrance of foreign matter following installation Where fittings are omitted from the drawings, they shall be the same size as the piping and in all cases shall conform to the piping code requirements

3 1 5 All pipe shall be carefully placed and supported at the proper lines and grades, and where practicable, shall be sloped to permit complete drainage Piping run shown on the drawings shall be followed as closely as possible, except for minor adjustment to avoid architectural and structural features If reallocations are required, they shall be subject to the approval of the Contractor

3 1 6 In the event that obstructions not shown on the drawings are encountered during the progress of the work that will require alterations to the drawings, the Contractor will have the authority to change the drawings and order the necessary de iations from the line or grade The Construction Subcontractor shall not make any deviation from the specified line or grade without approval by the Contractor Should any deviation in line or grade be permitted by the Contractor for the convenience of the Construction Subcontractor, any additional costs for thrust blocks, valves, blow-off assemblies, extra pipe footage, or other additional costs shall be borne by the Construction Subcontractor

3 1 7 Storage and Handling During storage, handling, and transporting, every precaution shall be taken to prevent injury to pipe Pipe shall be handled only by means of approved hooks on ends of sections, by means of fabric slings, or by other methods approved by the Contractor for the pipe used

3 1 8 Verification of dimensions All dimensions essential to the correct locations of the pipe, or fit of piping at equipment and valves, or to the avoidance of obstructions or conflict with other improvements, shall be accurately determined by the Construction Subcontractor prior to fabrication of the piping involved Any required change from the nominal locations shown on the drawings shall be made by the Construction Subcontractor and shall be included as a part of the work hereunder and will be subject to approval of the Contractor

3 1 9 Construction Subcontractor shall provide non-conducting dielectric connections wherever joining dissimilar metals

3 1 10 All valves shall be installed with stems upright and horizontal, not inverted Valve labels shall be applied to valves such that they are easily visible for the "normal" point of view Valve handles shall be labeled with function and arrows indicating which direction to turn the handle to "open" or "close" the valve

3 1 11 Piping shall be installed per manufacturer's installation instructions

3 2 Buried Pipe Installation

3 2 1 Buried piping shall be laid to the grades and alignment shown on the drawings and all trenching, bedding, and backfilling shall conform to Section 02200 Earthwork

3 2 2 The foregoing requirements shall govern the work, regardless of the type of pipe installed unless a more stringent requirement is specified When the work is not in progress, open ends of piping and fittings shall be securely closed The piping shall be placed when trench and weather conditions are suitable No pipe shall be laid in water, and responsibility for the diversion of drainage and dewatering of trenches during construction, including meeting all safety requirements, shall be borne by the Construction Subcontractor All piping in place shall be approved by the Contractor as to line, grade, bedding, and proper joint construction before backfilling In all backfilling operations, the Construction Subcontractor shall be responsible for preventing damage to or misalignment of the pipe No piping shall be buried until testing is completed and installation is approved by Contractor

3 2 3 Coverage Unless otherwise shown on the drawings, all buried piping shall have a coverage of at least 24 inches between the top of the pipe and the finished surface

3 2 4 Variations from the pipeline grade and alignment may be allowed to accommodate fabrication with the approval of the Contractor All changes of grade shall require the approval of the Contractor on the installation drawings

3 3 Testing

3 3 1 If the Construction Subcontractor is not on the Site Approved Supplier List (ASL), then all testing shall be conducted under direct supervision and verified by qualified Contractor personnel Testing shall be in accordance with Environment Management QAPjP, Sitewide Quality Assurance Project Plan

3 3 2 Leak testing of piping system integrity shall be by either hydrostatic or pneumatic test methods as listed below

3 3 2 1 Double contained polypropylene—Test inner pipe in accordance with SP-301, hydrostatic test (Class B), at 75 psi Test outer containment pipe in accordance with SP-301, pneumatic test (Class J) at 75 psi

3 3 2 2 PVC Pipe (All sizes)—Test PVC piping, in accordance with SP-301, hydrostatic test (Class B) at 75 psi

3 3 3 Construction Subcontractor shall identify piping components, i e , meters, instruments, that may not be designed for full hydrotest pressure and make provisions for testing the piping system with those components removed, as required

3 3 4 Leaks shall be located, repaired, and the line retested at expense of Subcontractor to the satisfaction of the Contractor

3 3 5 Warning Do not proceed with hydrostatic pressure tests above ground unless the construction supervisor has taken appropriate safety precautions

3 3 6 Pressure drops due to the thermal contraction are acceptable, if the pressure returns to the original test pressure after 2 hours

3 4 System Flushing

3 4 1 After tests are completed, piping shall be flushed In general, sufficient water shall be used to produce a minimum water velocity of 2 5 feet per second through piping being flushed Flushing shall be continued until discharge water shows no discoloration System shall be drained at low points

3 4 2 Construction Subcontractor shall not flush the 3-inch containment pipe as it is important to keep the annulus as dry as possible

SECTION 16050 - ELECTRICAL

1 Part 1 General

1 1 Summary

1 1 1 Scope of Work

1 1 1 1 Items specified in this section apply to high-level indicator, leak detection indicator, flow meter, and the power supply to support these indicators and flow meter

1 1 1 2 Furnish and install the following as shown on the drawings to ensure a complete and operable system

2 Part 2 Materials

2 1 High-Level Indicator and Leak Detection Indicator

2 1 1 Sensor shall be Flowline LV10-1301, vertical bouyancy sensor or Contractor approved equal (2 each) Strobe shall be Flowline LC09-1004, DC strobe alert or Contractor approved equal (2 each) mounted on Flowline LC06-1001 junction box and terminal strip or Contractor approved equal (2 each) Sensor shall be mounted on Flowline Smartrak LM10-1X01 (2 each, length per plans, X indicates length)

2 2 Flow Metering

2 2 1 Flow meter system shall consist of a SIGNET 8511 Compak Flow Transmitter or approved equal and a SIGNET 2535 Rotor-X Low-Flow Sensor or Contractor approved equal

2 3 Power Supply

2 3 1 Power supply shall be shared for the flow meter, the high-level indicator, and the leak detection indicator It shall consist of a solar electric generator Model Number ST60-2G27-24V, with voltage regulation, engineered and manufactured by Remote Power Inc or approved equal The solar electric generator is to be installed on a two-inch Schedule

40 steel pipe (ten feet long, secured 30 inches into the ground with concrete) The solar electric generator's battery enclosure, the two Flowline LC06-1001 junction boxes, and the flow transmitter are to be connected with ¾-inch rigid galvanized steel conduit through which the wiring connections are to be made The electrical connection between the terminal strip in the solar electric generator, the two Flowline LC06-1001 junction boxes, and the flow transmitter are to be made with THHN 14 gauge wire The electrical connection between the flow meter and the flow transmitter shall be made with #22 SHLD wire (supplied with sensor)

2 3 2 Recommended parts lists for terminal strip located in solar panel box

Manufacturer	Part No.	Wire Range	Quantity	Description
Allen-Bradley	1492-F1	#22 #14 AWG	6	Terminal Block Tubular screw with pressure plate (25 amp)
Allen-Bradley	1492-H7	#30 #12 AWG	2	Terminal Block High density isolating terminal block with finger safe terminals (15 amp)
Allen-Bradley	1492-N17	N/A	1	End Barrier Used to cover 1492 N17 open side of terminal block
Allen-Bradley	1492-N18	N/A	1	End Barrier Used to cover 1492 N18 open side of terminal block
Allen-Bradley	1492-N23	N/A	2	End Anchor Used to anchor ends of terminals on terminal strip
Allen Bradley	1492 N1	N/A	6" strip	Mounting Rail Breakaway mounting rail
Allen-Bradley	1492-N24	N/A	1	Jumper Strip Jumper is rated to carry 100% of rated terminal block current
Allen-Bradley	GBB-1	N/A	2	Ceramic Fuse Very fast acting fuse (1 amp)

2 3 3 Conduit and conductors schedule

Conduit #	Control Conductors	Size	Wire Type	Comments
100	2#14	¾"	THHN	High-Level Indicator (Flowline LV 1301 Vertical Buoyancy Sensor) (Flowline LC09 1004 DC Strobe Alert) (Flowline IC06 - 1001 Junction Box & Terminal Strip)
101	2#14	¾"	THHN	Leak Detection Indicator (Flowline LV 10 1301 Vertical Buoyancy Sensor) (Flowline LC09 1004 DC Strobe Alert (Flowline Lc06 1001 Junction Box & Terminal Strip)
102	2#14	¾"	THHN	Flow Transmitter (Signet 8511 Compak Flow Transmitter)
102A	#22 SHLD	¾"	THHN	Flow Meter (Signet 2535 Rotor X Low-Flow Sensor)

3 Part 3 Execution

3 1 Installation

3 1 1 Battery, battery box, and solar panel shall be installed as shown on plans and in accordance with manufacturer's instructions

3 1 2 High-level indicator, leak detection indicator, and flow meter shall be installed as shown on plans and in accordance with manufacturer's instructions

3 1 3 Inside the passive treatment tank, the ¾-inch galvanized steel conduit shall be attached to epoxy-mounted brackets rated to 100 psi vertical shear These brackets shall be installed on job by electrical subcontractor

3 2 Testing

3 2 1 The recommended procedure for testing the system is as follows

- Equipment needed
  - Volt Meter (Vdc)
  - Bucket filled with water
- General
  - Check the power at the terminal strip to make sure that each terminal is reading the correct voltage

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- Flow Transmitter

  - Follow the recommended procedure in the manual for installing and configuring the Signet Transmitter

- Leak Detection Sensor

  - First check to make sure that the unit is receiving power After the correct voltage is verified make sure all connections are secure Placing the bucket of water underneath the float sensor, raise the bucket until the sensor actuates the limit switch and the beacon is illuminated

- High Level Sensor

  - First check to make sure that the unit is receiving power After the correct voltage is verified make sure all connections are secure Placing the bucket of water underneath the float sensor, raise the bucket until the sensor actuates the limit switch and the beacon is illuminated

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Appendix A

Design Calculations
and
Product Specification Sheets

Table of Contents

1. Design Calculations for Settling Basin, Bag Filters, and Granular Activated Carbon Drum Filters

OU 7 Leachate Seep Design

9/21/95

Objective: Treat contaminants whose mean concentration in OU 7 seep water exceed applicable or relevant and appropriate requirements (ARARs) The remediation goal is to strive to meet ARARs As an interim action, all ARARs do not have to be met

Contaminants of Concern: Table 1 presents the summary statistics for the OU7 seep (SW097) The following analytes are identified as contaminants of concern (COCs) because their mean concentrations exceed the ARARs

- Metals
  - Aluminum - Figure 1 presents measured aluminum concentrations over time The value for 2/13/90 of 26,900 µg/L is an outlier and can be ignored The mean value excluding this outlier is 1523 µg/L The ARAR for total aluminum is 87 µg/L The mean dissolved concentration is 58 µg/L
  - Manganese - Figure 2 presents measured manganese concentrations over time The ARAR for manganese is consistently exceeded There appears to be a slight downward trend over the period the data was measured The mean total concentration is 1623 µg/L The ARAR for total manganese is 50 µg/L The mean dissolved concentration is 1582 µg/L Manganese is naturally occurring in the environment and concentrations above background are not necessarily an indication of contamination Manganese should not drive the remediation
  - Zinc - Figure 3 presents measured zinc concentrations over time The 2/13/90 value of 16,000 is an outlier and can be ignored The time trend for zinc shows a slight but steady decrease to values that approximately equal the ARAR. The mean value excluding the outlier is 2250 µg/L The ARAR for total zinc is 2,000 µg/L The mean dissolved concentration is 1438 µg/L
- Semivolatile organics
  - 2-Methylnapthalene - Figure 4 presents measured 2-methylnapthalene concentrations over time All the samples are detections and exceed ARAR. The mean concentration is 16 µg/L The ARAR is 10 µg/L
  - Naphthalene - Figure 5 presents measured naphthalene concentrations over time All the samples are detections and exceed ARAR The mean concentration is 18 µg/L The ARAR is 10 µg/L
- Volatile organics
  - Benzene - Figure 6 presents measured benzene concentrations over time The mean concentration is 2 µg/L The ARAR is 1 µg/L

- Methylene Chloride - Figure 7 presents measured methylene chloride concentrations over time The value for 2/13/90 of 190 µg/L is an outlier and is ignored The mean concentration is 14 µg/L The ARAR is 4 7 µg/L The presence of methylene chloride is not certain There are nine detections out of twenty samples Of these nine, two are outliers Of the remaining seven, five exceed the ARAR. However, methylene chloride is a common laboratory contaminant that is frequently detected in background samples Methylene chloride should not drive the remediation

- Vinyl Chloride - Figure 8 presents measured vinyl chloride concentrations over time The mean concentration is 5 µg/L The ARAR is 2 µg/L The presence of vinyl chloride is not of certain Only five detections occurred for twenty samples Three of these detections occurred in 1990, when sampling protocols were not as strict These 1990 samples are not validated Vinyl chloride should not drive the remediation

Design Constraints: The design flow for the treatment system will be 5 gallons per minute (gpm) The concentrations will be assumed to be the mean concentrations (The system will be able to handle larger flows and concentrations up to the maximum reported concentrations However, increased maintenance may be required under these conditions) The treatment system must be a passive system There is no electrical service to the site The system must therefore be either gravity-driven, solar-powered, or generator-driven Of these three, gravity-driven is the cheapest and the most maintenance-free The system design should strive to minimize construction costs, operating costs, and maintenance costs Wastes generated from the treatment of seep water will be disposed of in the Present Landfill The system's operating life is estimated at two years, although salvage of some system components to use during the 30-year closure period is possible

Treatment Process Selected: Carbon absorption was selected as the primary treatment Sedimentation was selected as a pretreatment for carbon absorption

System Configuration: Water is collected in a perforated PVC pipe drain and discharged to a settling basin Water is discharged from the settling basin to the reactor tank, where it undergoes filtration and granular activated carbon (GAC) treatment

Design Considerations for Collection System: The height of the inlet pipe to the settling basin must be maximized to maximize the head available to drive the water through the treatment system The PVC liner is placed approximately 2 5 feet below the pipe invert to help collect water just below the existing seep location Water flowing into this liner will have an upward flow component, just like water in an aquifer below a partially-screened well The collection system should not require maintenance over the two-year project life Cleanouts will be provided in case cleaning is required

Design Considerations for Settling Basin: To prevent fouling of the GAC media, GAC manufacturers recommend pretreatment of influent water by passing it through a 10 micron filter The settling basin is designed to remove particles greater 10 microns to the extent feasible

The seep water has a mean total suspended solids (TSS) concentration of 145 mg/L, with the measured range of concentrations 10 to 210 mg/L Table 2 presents the calculations for sizing the settling basin Based on these calculations, the minimum depth of the settling basin is 4 4 feet to the invert of the settling basin outlet The minimum area is 60 1 ft^2 For a 5 gpm flow with a TSS range of 100 to 200 mg/L, this size results in TSS outflow concentrations of 30 to 42 mg/L, respectively This remaining TSS should consist mainly of particles smaller than 15 microns (see Figure 22 5, Urbonas and Stahre, 1993, attached) At 5 gpm and an initial TSS of 145 mg/L, the buildup in a tank of this size is 0 9 feet over a two-year period The settling basin should not require clean-out over the two-year operating life If clean-out is required, the outlet pipe valve should be shut and the sediments pumped from the bottom One day should be allowed for settling before the outlet pipe is turned on again

Design Considerations for Filtration System: A bag filtration system is included as the first process in the treatment tank The filter housing can accomodate filters of different hole sizes Initial head losses across commercially available bag filters are approximately 0 25 psi As the filter operates, the head loss increases The passive system has approximately 4 feet of head available, or 1 7 psi No vender information is available for the filter capacity at 1 7 psi The filter capacity at 35 psi is on the order of 2,000 gm of particles (for each one of the two filter housing) At 1 7 psi, the capacity would be a fraction of that value If the capacity is 200 gm of particles per housing, at 35 mg/L TSS, 5 gpm, and 50% capture, the capacity would be reached in approximately one day Table 3 presents this calculation for a 2 housing bag filter Again, there are no specifications available regarding filter capacities at 1 7 psi The filter chosen is a high capacity filter with two housings in parallel Bag filters have lower head drops than cartridge filters The filters can be used initially with 10 micron bags If the required changeout time is too frequent, the filter can be used with 20 micron bags

Note the high-level indicator in the settling basin is designed as an alarm to indicate that the filters have plugged and require changeout

Design Considerations for Granular Activated Carbon System: The conceptual design presented a carbon-based media placed in a tank between gravel layers for inflow and outflow The current design uses instead 55-gallon drum reactors that are commercially available This configuration will result in vastly decreased costs for carbon change-out Table 4 presents the design calculations for the GAC system The actual rate of carbon usage with respect to the breakthrough of each compound cannot be known without large scale testing or, more likely for OU 7, actual operation of the system However, the theory and practice of activated carbon absorption support the concept that species that are not well absorbed can break through while absorption capacity is retained for easily absorbed species GAC manufacturers and vendors support the following premises (1) the breakthrough of poorly absorbed compounds does not significantly affect the absorption of better absorbed compounds, (2) more easily absorbed molecules can displace already absorbed molecules of compounds that are not well absorbed, and (3) the carbon usage as calculated for each individual species is a good initial estimate of the carbon usage for that particular species, although actual breakthrough will occur more quickly than indicated by the isotherm The application which is intended at OU 7, which is to let some compounds break through that are below ARARs, is a relatively common water treatment process Carbon usage for the

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treatment process is uncertain. Theoretical isotherms indicate that certain compounds (chloroethane in particular) will break through in days or weeks The first compound that exceeds its ARAR to break through (benzene) should take a few to several months to break through. There are two change-out options (1) change out only the first drum, placing a new drum as the final drum (would be required once every two months), and (2) change out all three drums drum (would be required once every three years) Option 1 should minimize carbon costs, while option 2 should minimize labor costs Since the reactor will be governed by confined space entry requirements and machinery will be required for drum change-out, option 2 will probably be cheaper

The operations plan should include periodic sampling before the third GAC drum Breakthrough for the second drum can be detected and breakthrough for the third drum can be estimated, allowing drum changeout before breakthrough of the third drum occurs

Expected Treatment Efficiencies: *For Organics* Volatile organic compounds and semivolatile organic compounds should be removed to below detection limits until breakthrough occurs Vinyl chloride will break through relatively quickly if the mean concentrations are present However, the presence of vinyl chloride is not certain Vinyl chloride is very volatile Some removal may occur in the settling basin It is recommended that the breakthrough of vinyl chloride be tolerated without carbon change-out Carbon change-out should occur with the breakthrough of benzene

For Metals· Significant reductions in aluminum and zinc concentrations should occur through the sedimentation process Dissolved concentrations of metals are based on samples that pass through a 0 45 micron filter The sedimentation process should take out most particles greater than 15 microns The concentrations after the sedimentation process should be somewhat greater than the dissolved concentrations The sedimentation process should succeed in meeting ARARs for zinc The ARAR for aluminum may or may not be met The efficiency of the system for removing manganese is highly questionable Over 97 percent of the manganese is dissolved The manganese most likely exists in a stable dissolved oxide form The sedimentation and GAC processes are not likely to remove the manganese The discharge concentrations of manganese will most likely exceed the manganese ARAR As stated before, the presence of manganese should not drive the remediation

Biocide and Scale Prevention: A commercially available biocide and scale preventer will be gravity fed into the system at the settling basin influent

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Table 1
ARARs Comparison for Leachate at the Seep (SW097)

Analyte	Detection Limit Range	Detection Frequency	Detections Exceeding ARARs	Minimum Result	Maximum Detection	Qualifier for Maximum Detection	Validation for Maximum Detection	Mean Result	ARAR	Units
METALS										
ALUMINUM	10 - 30000	16/19	13	29	26900	—	—	2629	87	UG/L
ANTIMONY	0 05 - 60	4/18	0	14	60 4	—	A	20	300	UG/L
ARSENIC	0 7 - 10	8/16	0	1 4	3	B	—	3	50	UG/L
BARIUM	0 02 - 50000	19/19	1	297	1550	—	—	645	1000	UG/L
BERYLLIUM	0 2 - 5	2/18	0	0 2	1 4	—	JA	1	4	UG/L
CADMIUM	0 1 - 16 5	4/18	0	1	7 6	—	—	3		UG/L
CALCIUM	14 5 - 100000	19/19	0	126000	212000	—	—	151737	TVS	UG/L
CHROMIUM	2 4 - 27 5	7/18	0	2	29 6	—	—	9	50	UG/L
COBALT	0 02 - 50	10/18	0	2 7	19 1	B	—	11	50	UG/L
COPPER	2 4 - 25	8/18	0	2	94 9	—	—	12	TVS	UG/L
IRON	4 7 - 30000	19/19	0	61300	155000	—	—	81005		UG/L
LEAD	0 8 - 2000	14/18	0	1 5	11	—	V	5	TVS	UG/L
LITHIUM	2 - 2000	15/19	0	34	107	—	V	48	2500	UG/L
MAGNESIUM	0 1 - 200000	19/19	0	29300	49000	—	—	34868		UG/L
MANGANESE	1 - 10000	19/19	19	1320	2490	—	—	1623	50	UG/L
MERCURY	0 02 - 0 2	1/18	0	0 1	0 28	—	—	0 1	10	UG/L
MOLYBDENUM	5 7 - 200	6/18	0	4	28 5	B	—	21		UG/L
NICKEL	0 02 - 40	5/18	0	5	31	—	V	12	125	UG/L
POTASSIUM	10 - 200000	18/19	0	5000	11700	—	—	6511		UG/L
SELENIUM	1 1 - 5	2/18	0	1 1	7	W	—	2	17	UG/L
SILVER	2 6 - 25	8/18	0	2 7	16 7	—	—	5	50	UG/L
SODIUM	10 - 50000	19/19	0	57700	110000	—	V	71468		UG/L
STRONTIUM	3 5 - 10000	17/19	0	814	1370	—	—	920		UG/L
TIN	10 - 200	8/18	0	11	243	—	—	48	8000	UG/L
VANADIUM	3 2 - 10000	12/19	1	3 1	211	—	—	25	100	UG/L
ZINC	1 8 - 10000	19/19	16	857	16000	—	—	2974	2000	UG/L
PESTICIDES										
alpha BHC	0 05 - 0 28	1/3	0	0	0	I	—	0 06		UG/L

Table 1
ARARs Comparison for Leachate at the Seep (SW097)

Analyte	Detection Limit Range	Detection Frequency	Detections Exceeding ARARs	Minimum Result	Maximum Detection	Qualifier for Maximum Detection	Validation for Maximum Detection	Mean Result	ARAR	Units
RADIONUCLIDES										
AMERICIUM-241	0 - 0 013	16/16	0	-0 000404	0 02121	—	V	0 007	30	PCI/L
CESIUM 137	0 47 - 1	14/14	0	-0 21	0 6057	J	—	0 15	3000	PCI/L
GROSS ALPHA	1 5 - 7 4	8/8	0	0 8918	6 639	—	V	2 9		PCI/L
GROSS BETA	1 69 - 11 5	8/8	0	3 753	17	—	V	10		PCI/L
PLUTONIUM-238	0 01 - 0 01	2/2	0	-0 000465	0 00222	J	A	0 00088	30	PCI/L
PLUTONIUM-239	0 003 - 0 003	1/1	0	0 009	0 009	—	—	0 009	30	PCI/L
PLUTONIUM-239/240	0 - 0 013	16/16	0	0 001	0 01606	—	A	0 007	30	PCI/L
RADIUM-226	0 03 - 0 03	1/1	0	0 58	0 58	—	A	0 58	100	PCI/L
STRONTIUM-89,90	0 21 - 1	9/9	0	0 66	4 06	—	V	1 35	8	PCI/L
STRONTIUM-90	0 2 - 0 59	3/3	0	0 5442	1 1	—	—	0 7		PCI/L
TRITIUM	155 - 450	19/19	1	185 4	1500	—	A	393	1000	PCI/L
URANIUM-233,-234	0 1 - 0 6	12/12	0	-0 0238	4 2	B	A	0 8	500	PCI/L
URANIUM-235	0 - 0 6	12/12	0	-0 012	0 084	J	A	0 03	600	PCI/L
URANIUM-238	0 086 - 0 6	12/12	0	0 03914	3 76	—	A	1	600	PCI/L
SEMIVOLATILE ORGANICS										
2,4 DIMETHYLPHENOL	10 - 10	1/5	0	3	3	J	A	5	36	UG/L
2-METHYLNAPHTHALENE	10 - 10	5/5	5	12	23	—	V	16	10	UG/L
4 METHYLPHENOL	10 - 10	3/5	0	2	4	J	—	4		UG/L
ACENAPHTHENE	10 - 10	5/5	0	2	3	J	A	3	520	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	10 - 12	1/5	0	2	2	J	A	5	10	UG/L
DIBENZOFURAN	10 - 10	5/5	0	1	2	J	A	1	10	UG/L
DIETHYL PHTHALATE	10 - 10	4/5	0	1	3	J	A	3	200	UG/L
FLUORENE	10 - 10	5/5	0	2	3	J	A	2	10	UG/L
NAPHTHALENE	10 - 10	5/5	5	14	22	—	V	18	10	UG/L
PHENANTHRENE	10 - 10	5/5	0	4	5	J	A	4	10	UG/L
VOLATILE ORGANICS										
1,1-DICHLOROETHANE	5 - 5	17/20	0	2	10	—	V	6	59	UG/L
1 2-DICHLOROETHENE	5 - 5	10/20	0	2	14	—	V	4	70	UG/L
2-BUTANONE	10 - 10	6/19	0	6	76	—	V	12	280	UG/L
2-HEXANONE	10 - 10	1/20	0	1	10	—	V	5	50	UG/L
4 METHYL-2-PENTANONE	10 - 10	5/20	0	10	87	J	A	11	140	UG/L

Table 1
ARARs Comparison for Leachate at the Seep (SW097)

Analyte	Detection Limit Range	Detection Frequency	Detections Exceeding ARARs	Minimum Result	Maximum Detection	Qualifier for Maximum Detection	Validation for Maximum Detection	Mean Result	ARAR	Units
ACETONE	10 - 10	10/20	0	10	220	—	A	34	280	UG/L
BENZENE	5 - 5	11/20	4	1	2	J	—	2	1	UG/L
CARBON DISULFIDE	5 - 5	1/20	0	5	6	—	—	3		UG/L
CHLOROETHANE	10 - 10	15/20	0	10	57	—	V	22		UG/L
CHLOROMETHANE	10 - 10	2/20	1	4	7	J	A	5	5 7	UG/L
ETHYLBENZENE	5 - 5	19/20	0	1	18	—	—	13	57	UG/L
METHYLENE CHLORIDE	5 - 5	9/20	5	3	190	B	—	14	4.7	UG/L
o-XYLENE	5 - 5	3/4	0	5	8	—	—	6		UG/L
TETRACHLOROETHENE	5 - 5	2/20	0	1	1	J	—	2[1]	1	UG/L
TOLUENE	5 - 5	19/20	0	5	88	—	—	38	1000	UG/L
TOTAL XYLENES	5 - 5	19/20	1	1	25	J	A	14	10000	UG/L
TRICHLOROETHENE	5 - 5	11/20	1	1	4	J	—	2	2 7	UG/L
VINYL ACETATE	10 - 10	1/19	5	10	49	—	—	7[2]	6	UG/L
VINYL CHLORIDE	10 - 10	5/20	0	3	11	—	V	5	2	UG/L
WATER QUALITY PARAMETERS										
BICARBONATE AS CACO3	1000 - 10000	15/15	0	554000	705000	—	V	595800		UG/L
CARBONATE AS CACO3	1000 - 10000	2/9	0	0	0	—	—	3889		UG/L
CHLORIDE	100 0 - 50000	14/14	0	1800 0	66300 0	—	V	53650		UG/L
CYANIDE	10 - 20	1/14	0	1 5	36 8	—	—	9	200	UG/L
DISSOLVED ORGANIC CARBON	1000 - 1000	4/4	0	14000	27000	—	JA	18750		UG/L
FLUORIDE	100 0 - 200 0	12/12	0	390 00	540 00	—	V	469 2	2000	UG/L
NITRATE/NITRITE	20 00 - 200 0	6/10	0	20 00	870 00	—	V	263	10000	UG/L
NITRITE	20 00 - 20 00	6/9	0	20 00	63 000	—	V	30 33	500	UG/L
OIL AND GREASE	200 0 - 11100 0	4/12	0	800 0	42100 0	—	V	7013		UG/L
ORTHOPHOSPHATE	10 00 - 200 0	3/10	0	50 00	150 00	—	—	60 9		UG/L
pH		5/5	0	6 8	7 3	—	—	7		PH
PHOSPHORUS	50 00 - 1000	9/9	0	95 000	1380	—	—	387		UG/L
SILICA	400 0 - 2000	3/3	0	7400 0	43000	—	—	19567		UG/L
SILICON	7 3 - 2000	13/13	0	7060	44000	—	—	13547		UG/L
SOLIDS, NONVOLATILE SUSPENDED	5000 - 5000	6/6	0	10000	199000	—	—	83167		UG/L
SULFATE	200 0 - 25000	5/14	0	200 0	29600 0	—	V	5084	250000	UG/L
TOTAL DISSOLVED SOLIDS	10000 - 10000	15/15	0	470000	870000	—	—	729333		UG/L

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Table 1
ARARs Comparison for Leachate at the Seep (SW097)

Analyte	Detection Limit Range	Detection Frequency	Detections Exceeding ARARs	Minimum Result	Maximum Detection	Qualifier for Maximum Detection	Validation for Maximum Detection	Mean Result	ARAR	Units
TOTAL ORGANIC CARBON	1000 - 1000	3/3	0	19000	24500 0	—	V	20833		UG/L
TOTAL SUSPENDED SOLIDS	4000 - 5000	12/12	0	10000	250000	—	—	144667		UG/L

Shaded analytes indicate mean result exceeds ARAR
All analytes are total analytes unless otherwise noted
Analytes with zero detections are not reported
For non-detects, one-half the detection limit is used in calculating the mean result
[1] For tetrachloroethene, the maximum detection equals the ARAR, the mean exceeds the ARAR because one-half detection limit for non-detects exceeds the ARAR
[2] For vinyl acetate, one detection out of nineteen causes mean to exceed ARAR, suggests that one detection is outlier and should be discarded

Data Qualifiers
— = data qualifier field in database is blank
B = for inorganics, reported value is < Contract Required Detection Limit but > Instrument Detection Limit (estimated value)
B = for organics, analyte is also detected in blank,
for common lab contaminants include as detection if blank result > 10 times detection limit,
for all other organics include if blank result > 5 times detection limit
B = for radionuclides, constituent also detected in blank whose concentration was > minimum detectable activity
I = organics, interference with target peak (estimated value)
J = for organics, Matrix Spike data indicate presence of compound but below detection limit (estimated value)
U = for inorganics and organics, analyte analyzed but not detected at the quantitation limit
W = inorganics post-digestion spike for Graphite Furnace Atomic Absorption analysis is out of control limits while sample absorbance is less than 50% of spike absorbance

Data Validation Codes
— = data validation field in database is blank
A = acceptable result
JA = acceptable result (for estimated value)
V = valid result

Table 2
Calculation of Settling Velocities for Particles and Sizing of Settling Basin
Calculation 1: Basin Volume using Settling Velocity from Stokes' Law

Settling Velocity (from Stokes' Law, Thomann and Mueller, Principles of Surface Water Modeling and Control, Harper Collins Publishers, 1987)

$v_s = 0\ 033634\ (rho_s - rho)\ d^2$

where

d = diameter of particle, um =	5	10	50
rho_s [1] = density of particle, g/cm^3 =	1 57	1 42	1 11
rho = density of water, g/cm^3 =	1	1	1
v_s = settling velocity, m/day =	0 48	1 40	9 43

[1] Empirically, $rho_s = 2\ 0 * d^{(-0\ 15)}$

Another empirical study notes that settling velocities of lacustrine and marine particles are up to an order of magnitude higher than Stokes' velocity

Settling velocity based on Stokes' velocity for 10 um particle is 1 4 m/day
Larger particles should have greater settling velocities Stokes' velocity should underestimate the settling velocity

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Table 2
Calculation of Settling Velocities for Particles and Sizing of Settling Basin
Calculation 1: Basin Volume using Settling Velocity from Stokes' Law (continued)

Hazen's Surface Load Theory (Urbonas, Ben, and Stahre, Peter, Stormwater, Best Management Practices and Detention for Water Quality, Drainage, and CSO Management PTR Prentice Hall, 1993)

$A = W * L$

$V = A * D$

$T = V / Q = (A * D) / Q$

Where
A = area
W = width
L = length
V = volume
D = depth
T = time for flow to pass through the basin
Q = flow rate

For a particle to settle to the bottom as it passes through the basin, its average descent velocity must be at least

$v_s = D / T = Q / A$

v_s	1 4	m/day	(from calculation above)
Q (gpm)	5	gpm	
Q (m^3/day)	27 3	m^3/day	
minimum A =	19 5	m^2	

Turbulent flow can cause resuspension and reduce removal to only 60% of particles
To reduce turbulence, average basin depth should be no less than 3 5 feet (suggested depths 5 to 12 feet)

Assume D = 4 ft = 1 2 m

T = (A * D) / Q = 0 87 days = 21 hours

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Table 2
Calculation of Settling Velocities for Particles and Sizing of Settling Basin

Calculation 2: Basin Volume Based on Empirical Data

Studies of settling times and % removal based on initial TSS produced the following results
From Urbonas and Stahre, Figure 22 9, p 335

Settling Time (hours)	Initial TSS (mg/L)	% Removal	Final TSS (mg/L)
2	100	58	42
6	100	70	30
24	100	83	17
48	100	90	10
2	200	65	70
6	200	79	42
24	200	86	28
48	200	90	20

A six-hour settling time results in a final TSS in the range of 30 - 42 mg/L (down from initial range of 100 - 200 mg/L)

Let T =	6	hours =	0 25	days
Q (gpm)	5	gpm		
Q (m^3/day)	27 3	m^3/day		
V = Q * T =	6 8	m^3 =	240 4	ft^3
Depth, D	1 2	m =	4	ft
Area, A	5 6	m^2 =	60 1	ft^2

Table 2
Calculation of Settling Velocities for Particles and Sizing of Settling Basin

Calculation 2: Basin Volume Based on Empirical Data (continued)

Volume of Settled Particles per Day

TSS Conc (mg/L)	Flow (gpm)	Flow (liter/day)	TSS (mg/day)	Conversion (mg/ cm^3)	TSS (cm^3 /day)	TSS (liters/day)	TSS(ft^3/day)
145	5	27288	3956760	1825	2168	2 17	0 08

If density of settled particles is midway between that of water (1000 mg/cm^3) and that of a solid soil particle (2650 mg/cm^3), or 1825 mg/cm^3, the volume of settled TSS per day is 0 08 ft^3

Volume of Settled Particles for Different Time Periods

	TSS (1 day)	TSS (1year)	TSS (2 years)	TSS (3 years)
Volume (ft^3)	0 08	27 9	55 9	83 8
Tank Area (ft^2)	60	60	60	60
Depth of Settled Particles (ft)	0 001	0 5	0 9	1 4

Depth of settled particles is 0 9 feet after 2 years If minimum depth for settling basin is 3 5 feet, then minimum design depth should be 4 4 feet to bottom of outlet

STORMWATER

Best Management Practices and Detention for Water Quality, Drainage, and CSO Management

BEN URBONAS
Urban Flood Control District • Denver • Colorado

PETER STAHRE
Malmo Water and Sewer Works • Malmo • Sweden

1993

PTR Prentice Hall, Englewood Cliffs, New Jersey 07632

22 3 HAZEN'S SURFACE LOAD THEORY

Hazen's surface load theory assumes that for a particle to be permanently removed from the water column, it must reach the bottom of a basin before the water carrying it leaves the basin Consider a long rectangular basin of length L, width W, and depth D The surface area A of the basin is then

$$A = W \ L \tag{22 6}$$

and the volume V is

$$V = A \ D \tag{22 7}$$

Further, assume that fluid passing through the basin at a flow rate of Q is uniformly distributed over the cross-section $W \ H$ and that all the particles which have time to sink to the bottom will be permanently removed from the fluid The descent height is the largest for particles entering the basin at the water surface (i e , D, the depth of the basin)

The time T for the flow to pass through the basin can be given by

$$T = \frac{V}{Q} = \frac{(A \ D)}{Q} \tag{22 8}$$

For a particle to settle to the bottom as it passes through the basin, its average descent velocity has to be at least

$$v_t = \frac{D}{T} = \frac{Q}{A} \tag{22 9}$$

It can thus be stated that the sedimentation effect of a basin can be expressed by the ratio between Q and A, which is sometimes referred to as the surface load Equation 22 9 states that the surface load is equal to the descent rate of the smallest particle that can just be separated in the basin

This surface load theory presupposes that the flow through the basin is uniform and laminar Unfortunately, these are not the conditions found in practice A field installation can experience multilayered flow, turbulence, eddies, circulation currents, diffusion at inlets and outlets, etc (see Figure 22 3) Some investigators speculate that under turbulent conditions no more than 60% of the removal predicted using Hazen theory is achieved In design, correction factors are used to compensate for this observed difference between theory and actual performance

According to the preceding equations, depth has nothing to do with sediment removal in a basin However, because of turbulence, diffusion, and local velocities, sediments can be resuspended from the bottom To reduce the chances of resuspension, it is recommended that the average basin depth be no less than 3 5 feet (1 07 m) It is suggested, however, that sedimentation basins be betw and 12 feet (1 5 and 3 5 m) deep

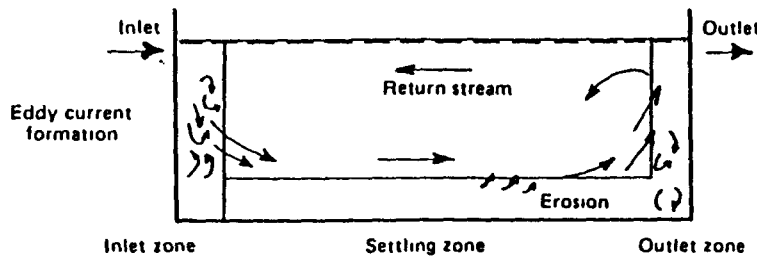


Figure 22 3 Examples of flow disturbances in a basin

22 4 SEDIMENTATION IN STORMWATER UNDER QUIESCENT CONDITIONS

Until the early 1980s, very few studies dealt with the separation of pollutants from stormwater by sedimentation One of these is further commented on here, namely, the work by Peter Stahre in Sweden Since then, studies by Rinella and McKenzie (1983), Randall et al (1982), and Whipple and Hunter (1981) have produced significant new information about the settling characteristics of TSS and associated pollutants Nevertheless, the literature on this topic is still very limited

22 4 1 Stahre's Findings

A more comprehensive study of sedimentation properties of TSS in stormwater was conducted by Stahre He investigated how particle size distribution and particle volume varies with time Using a pipette, Stahre sampled water in a settling tube at various times after settling was permitted to begin During the first hour, samples were taken at 5-minute intervals After that, additional samples were taken at 90 and 120 minutes Each sample was analyzed for particle size distribution, and the particle volume distribution by particle size was calculated

Figures 22 4 and 22 5 depict Stahre's findings of particle numbers and volumes for each size fraction in the water column as a function of sedimentation time Both figures show results only for particles smaller than 25 microns

As can be seen in Figure 22 4, the number of particles in the 5 to 10 micron size appears to increase rapidly during the first hour and continues to increase for a total of 90 minutes from the start of the test After that, the number of particles appears to decrease Something similar was observed for the 10 to 15 micron size fraction, except the numbers increased only very slightly for the first 15 minutes

An explanation for this apparently unusual finding was ered by Stahre He speculated that the equipment that counted the partic ay have

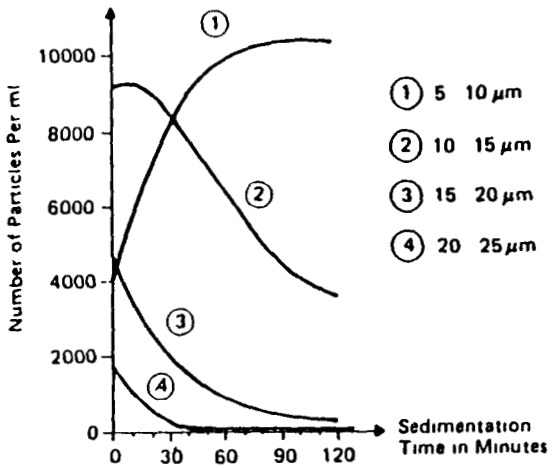


Figure 22 4 Number of particles in water column as a function of sedimentation time

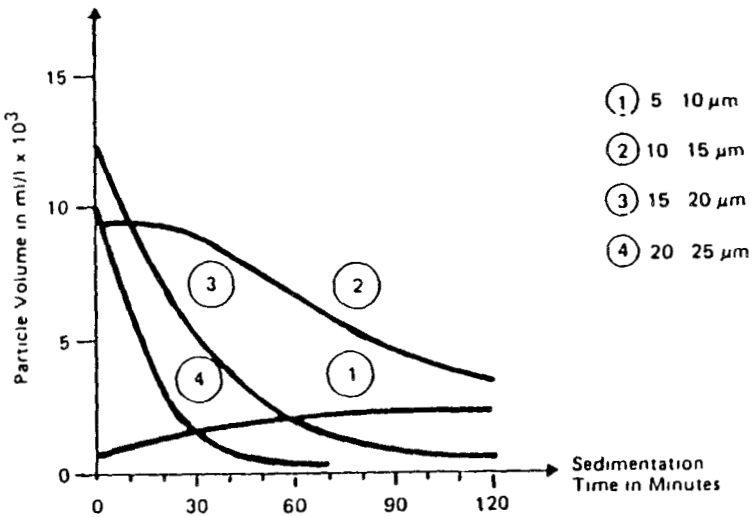


Figure 22 5 Volumes of particles as a function of sedimentation time

mistaken small air bubbles in the water for particles He did not, however, explain what may have caused the small air bubbles to appear early in the test Regardless, because the 5 to 10 micron particles are very small, they contribute very little to the volume estimates of the suspended solids in the water column (see Figure 22 5)

By compositing all of the size fractions into a single volume of suspended solids, Stahre obtained a very smooth, exponentially decaying curve This is shown in Figure 22 6, where the effect of sedimentation time is related to the total volume of suspended solid particles remaining in the water column

22 4 2 Randall's Findings

Randall et al (1982) reported results of laboratory settling tube tests of seven urban stormwater runoff samples They found that the TSS concentration after 48 hours of sedimentation leveled off to between 5 and 10 milligrams per liter (see Figures 22 7 and 22 8) This is similar to the findings reported for sedimentation tunnels in Sweden, where the TSS concentrations bottomed out at 10 milligrams per liter Although the settling tube tests appear to have somewhat lower final concentrations, both sets of results indicate a practical bottom limit of approximately 10 milligrams per liter in the removal of TSS by sedimentation

The Randall et al findings confirm another observation in Sweden, namely the percentage of TSS removed increased as the initial TSS concentration increased Stahre and Urbonas plotted Randall's data as percent TSS

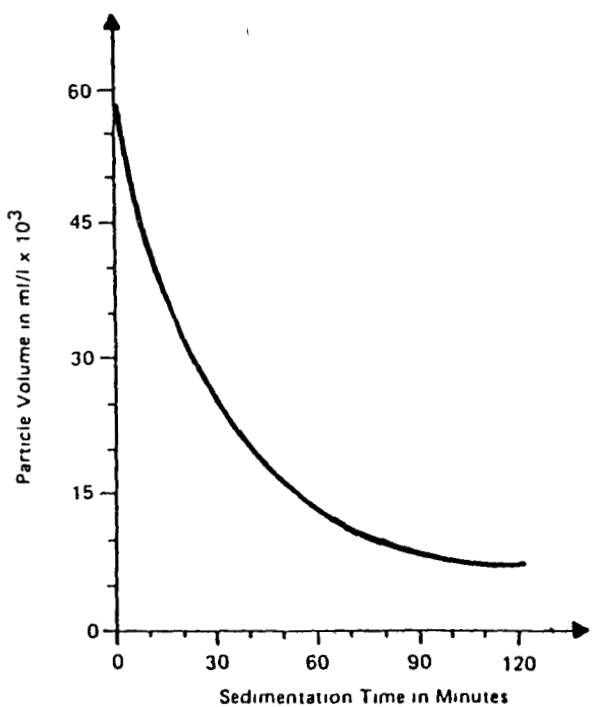


Figure 22 6 Effects of sedimentation time on total particle volume in stormwater

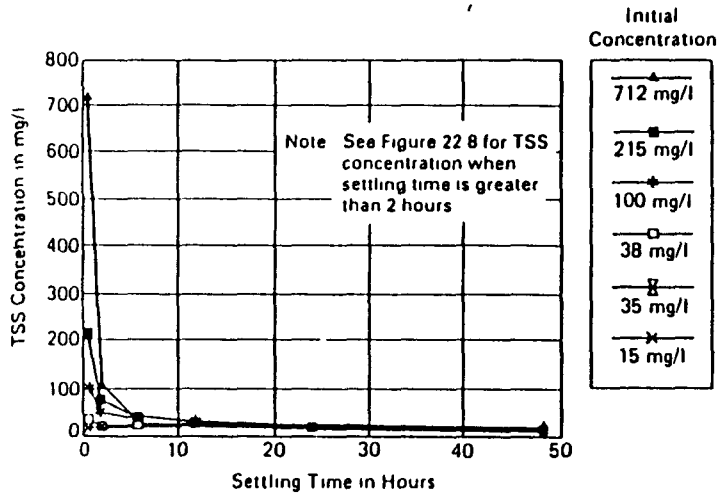


Figure 22 7 Effects of time of sedimentation on TSS concentrations (After Randall et al , 1982)

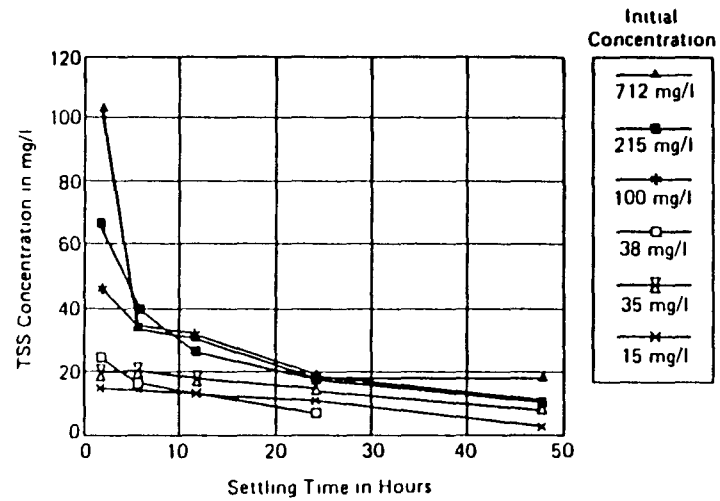


Figure 22 8 Effects of time of sedimentation 2 to 48 hours, on TSS concentrations (After Randall et al , 1982)

removed vs initial concentration (see Figure 22 9) This graph clearly indicates that the TSS removal efficiencies are very poor when initial concentrations are around 10 milligrams per liter The removal efficiencies increase rapidly as the initial concentration increases to about 100 milligrams per liter, after which the removal efficiency begins to level off

In addition to TSS, Randall's group also conducted settling characteristics tests in settling tubes for several other constituents found in the same stormwater samples None of the other constituents exhibited the same consistency or uniformity in removal efficiencies found for TSS However, it was clear that sedimentation was able to reduce their concentrations in water Figures 22 10 through 22 14 contain graphs showing percent removal vs sedimentation time for several of the constituents

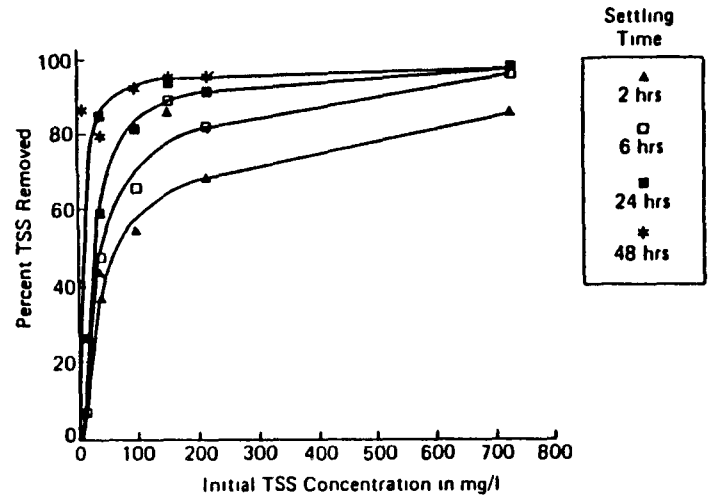


Figure 22 9 Effects of initial TSS concentration on removal rates (After Randall et al , 1982)

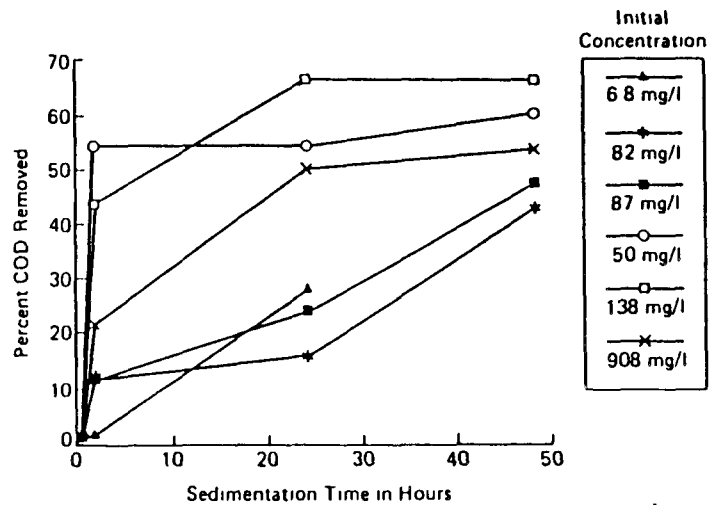


Figure 22 10 Percent COD removed vs sedimentation time (After Randall et al , 1982)

Table 3
Design Calculation for Bag Filter

TSS (mg/L)	Flow (gpm)	Flow (L/day)	TSS captured (g/day) (assume 10% capture)	Filter capacity (2 housings) at 1 1 psi (estimated) (g)	Time between Filter Changeout (days)
35	5	27,288	96	400	4 19

89

Table 4
Design Calculations for Granular Activated Carbon Usage

Compound	K	1/N	Mean Concentration (mg/L)	% Sorp	Carbon lbs/24 hours
1,1-DCA	1 790	0 530	0 006	0 012	3 03
Benzene	3 300	0 430	0 002	0 023	0 53
Chloroethane	0 590	0 950	0 022	0 002	84 03
Naphthalene	132 000	0 420	0 018	2 442	0 04
Vinyl Chlonde	0 590	0 950	0 006	0 000	78 74

Assumptions
Data generated by theoretical liquid phase adsorption isotherm prediction
K = intercept of adsorption isotherm with the axis (log-log plot)
N = slope of the adsorption isotherm (log-log plot)
System assumed to be at 70 ° F and 760 mm Hg using carbon with
a pore volume of 0 70 ml/g

Flow rate is 5 gpm

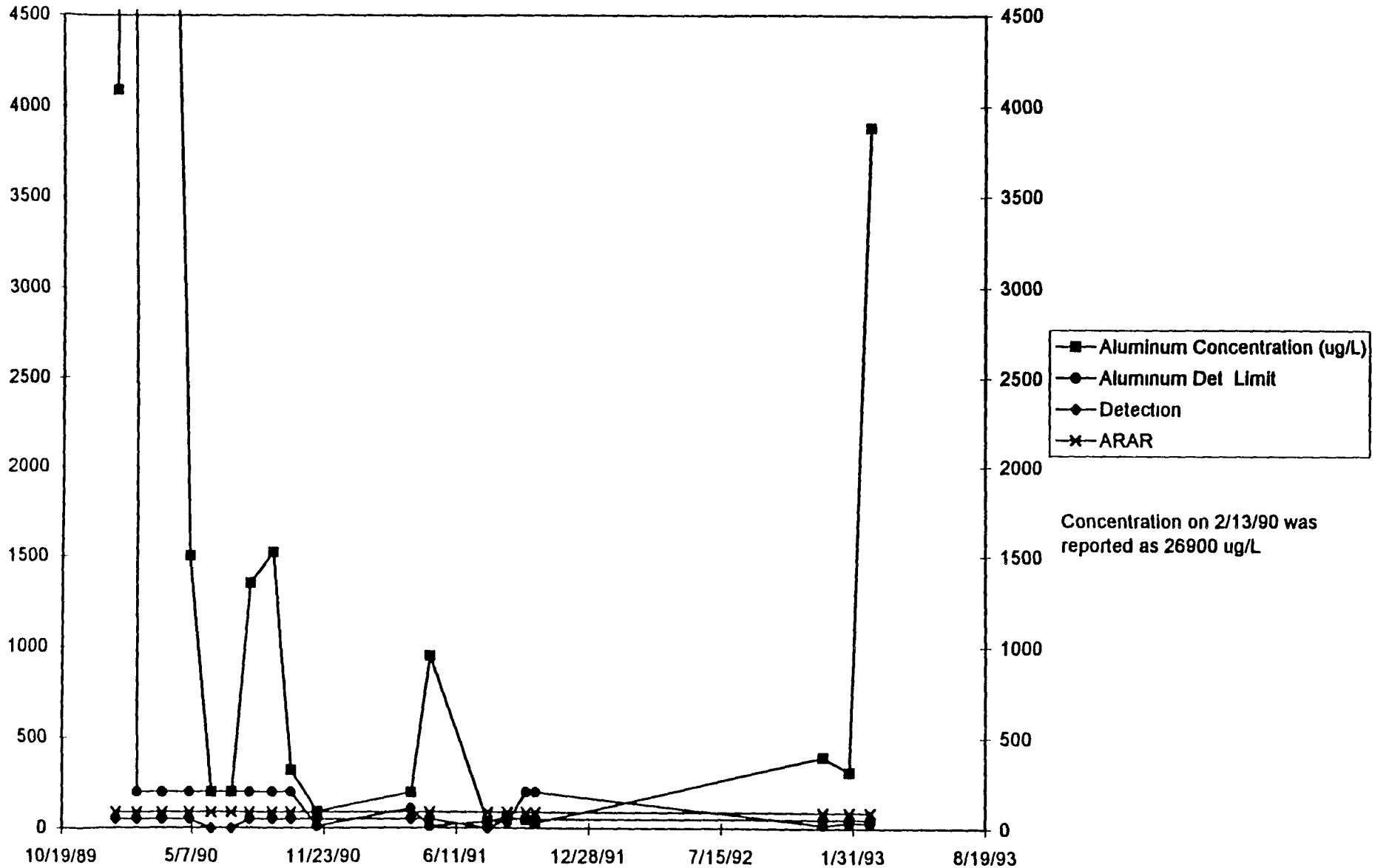
K for 2-methylnaphthalene is not available, carbon usage should be similar to that for naphthalene

If vinyl chlonde can be ignored (see text), the compound exceeding an ARAR that has the greatest carbon usage is benzene

Carbon/drum (lbs)	Usage/day (lbs/day)	Days/drum	Days/(3 drums)
200	0 53	377	1132

90

Figure 1
Total Aluminum Concentrations Over Time

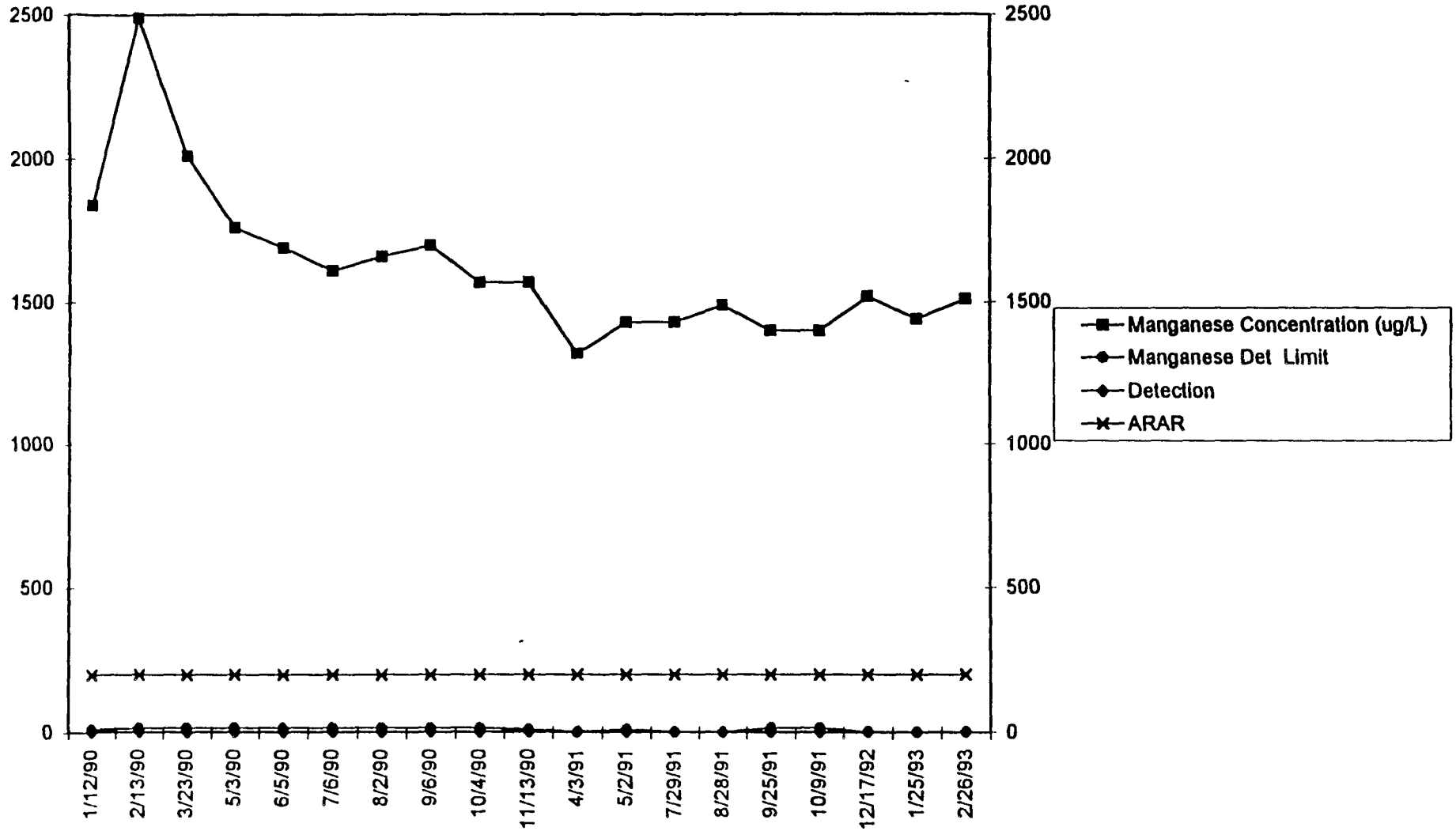


Concentration on 2/13/90 was reported as 26900 ug/L

8/28/95

ALUM1 XLS

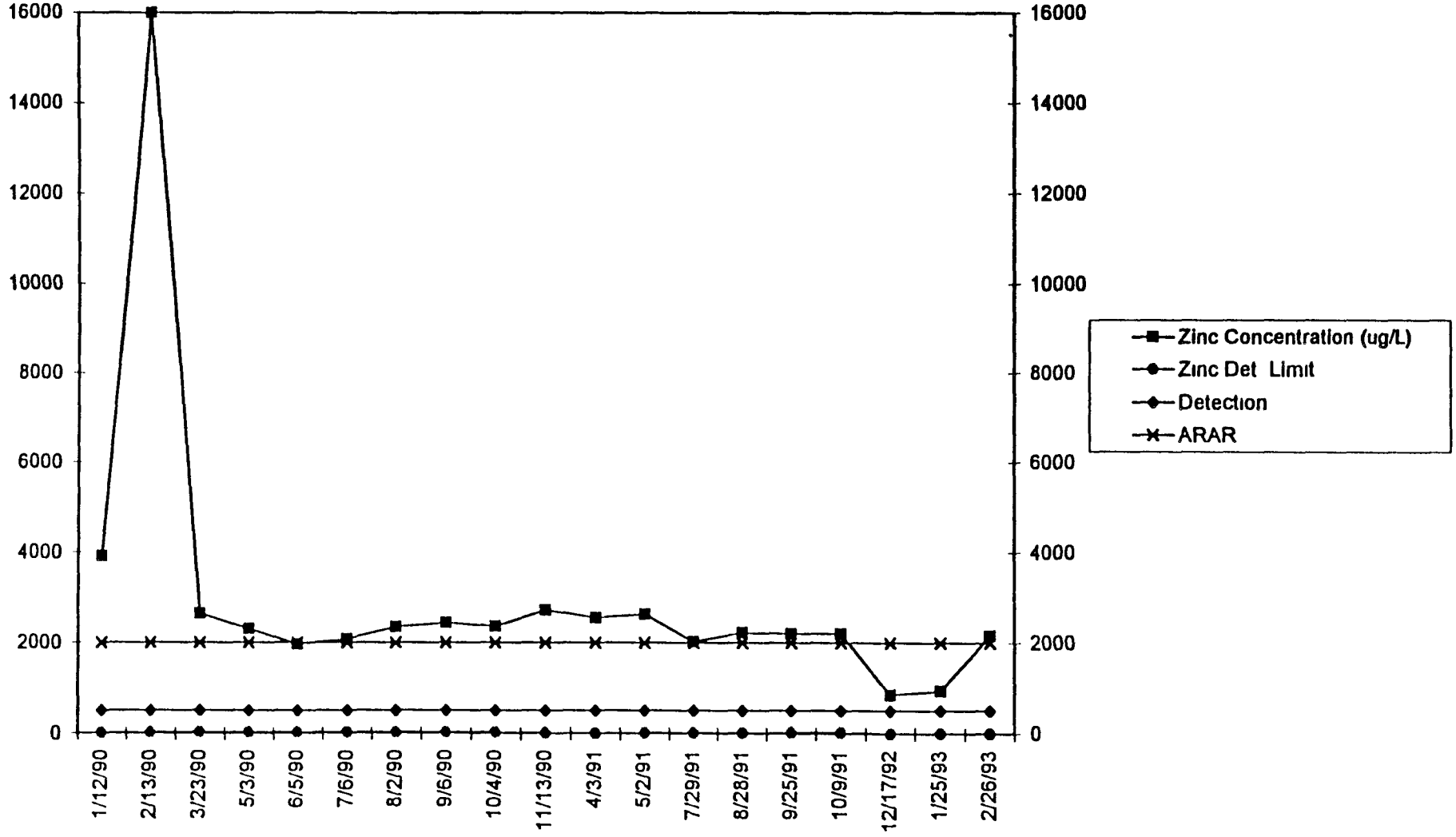
Figure 2
Total Manganese Concentrations Over Time



8/28/95

SEEP_EX1 Y ` MN

Figure 3
Total Zinc Concentrations Over Time

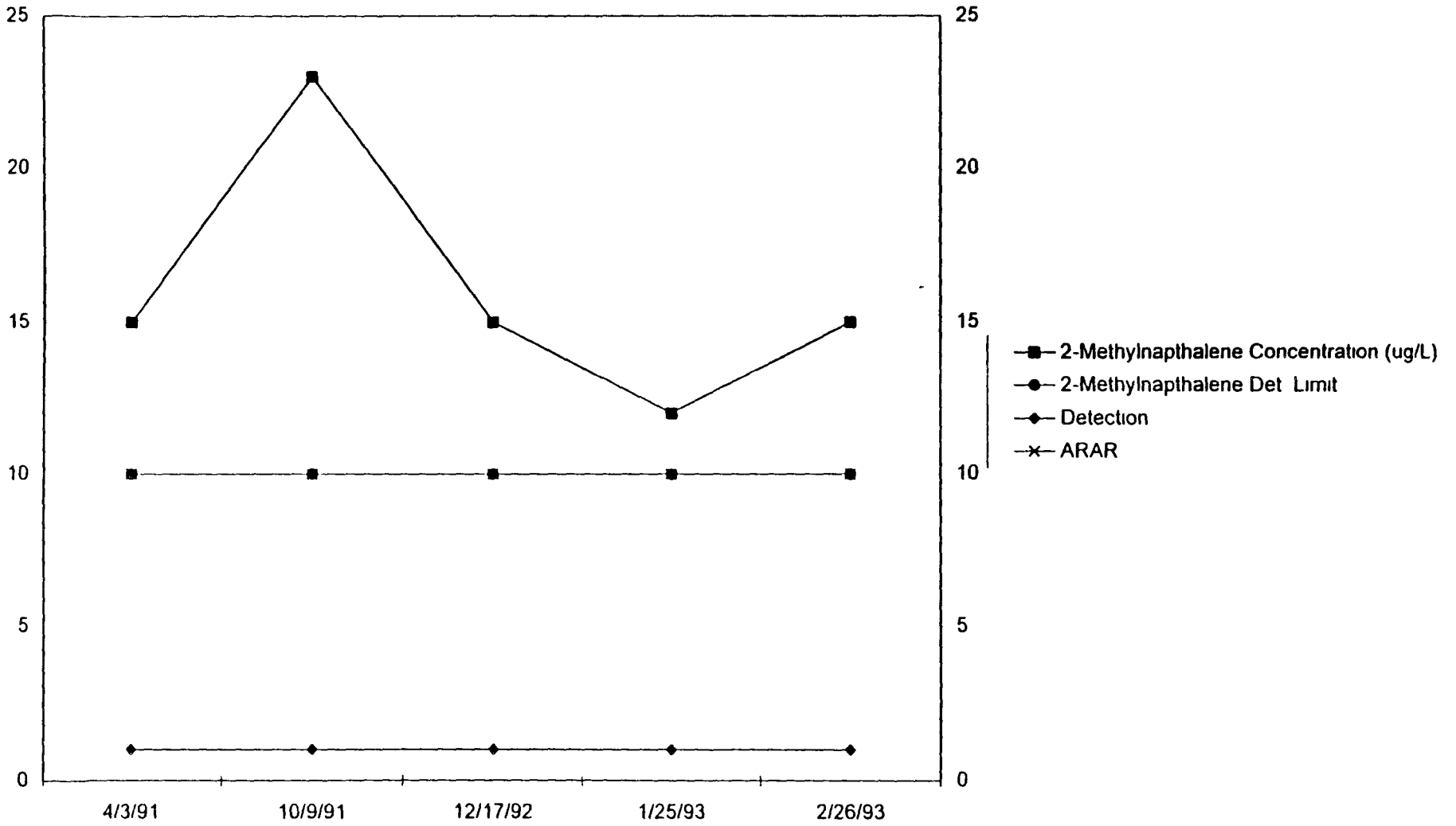


93

8/28/95

SEEP_EX1 XLS ZN

Figure 4
2-Methylnapthalene Concentrations Over Time

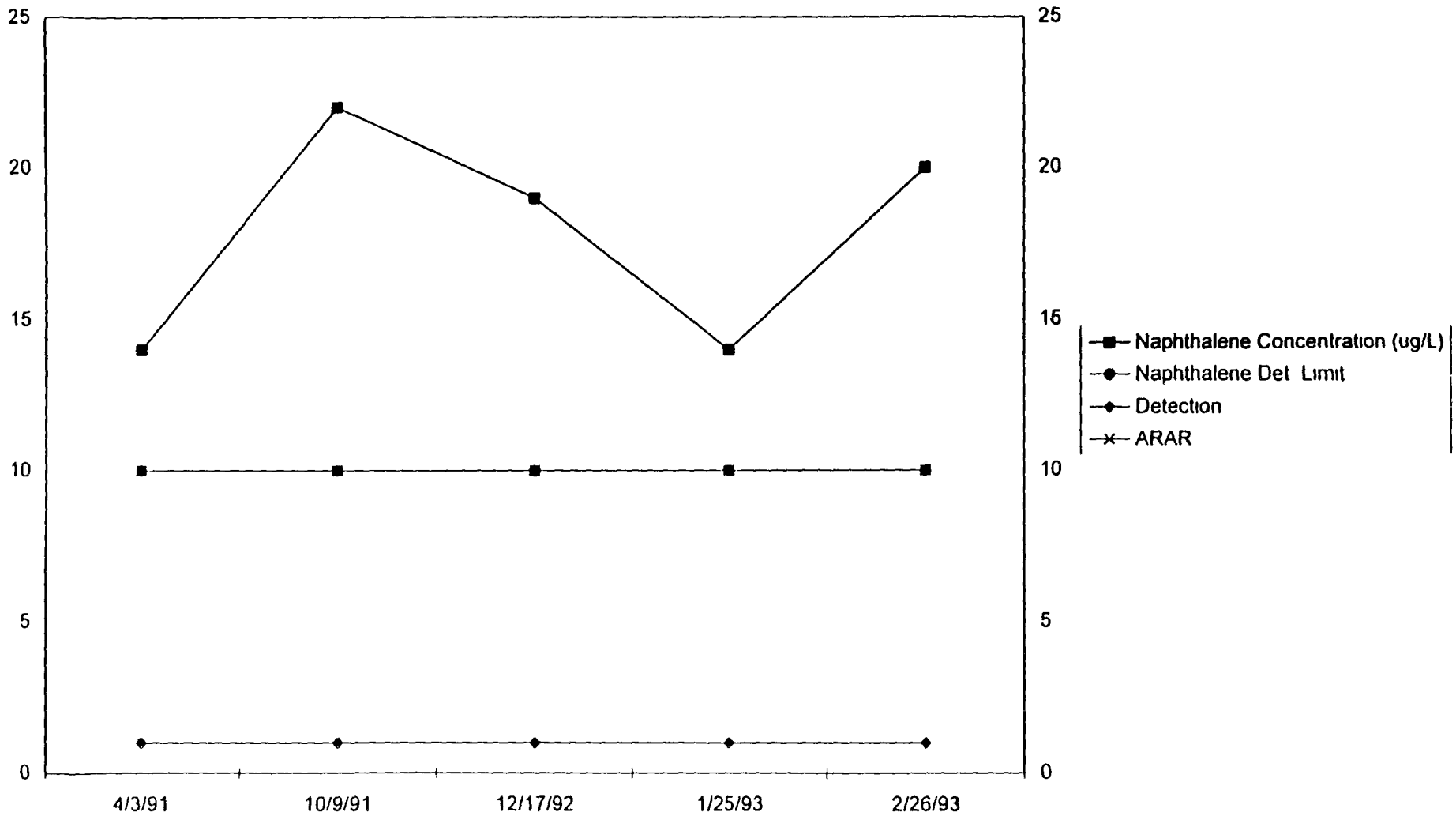


7/10/95

SEEP_EX1 XLS 2-M

94

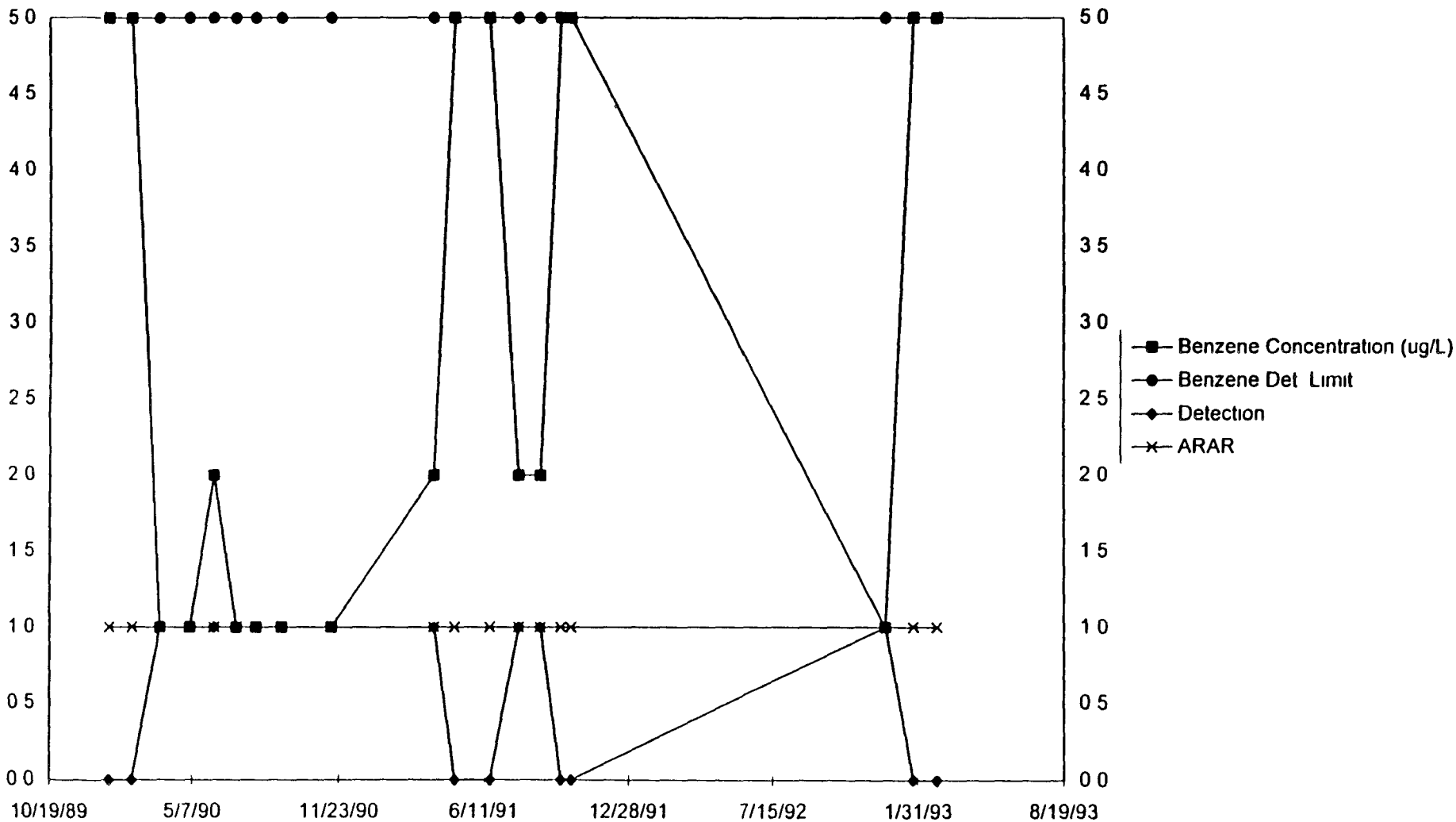
Figure 5
Napthalene Concentrations Over Time



7/10/95

SEEP_EX1 XLS NAPH

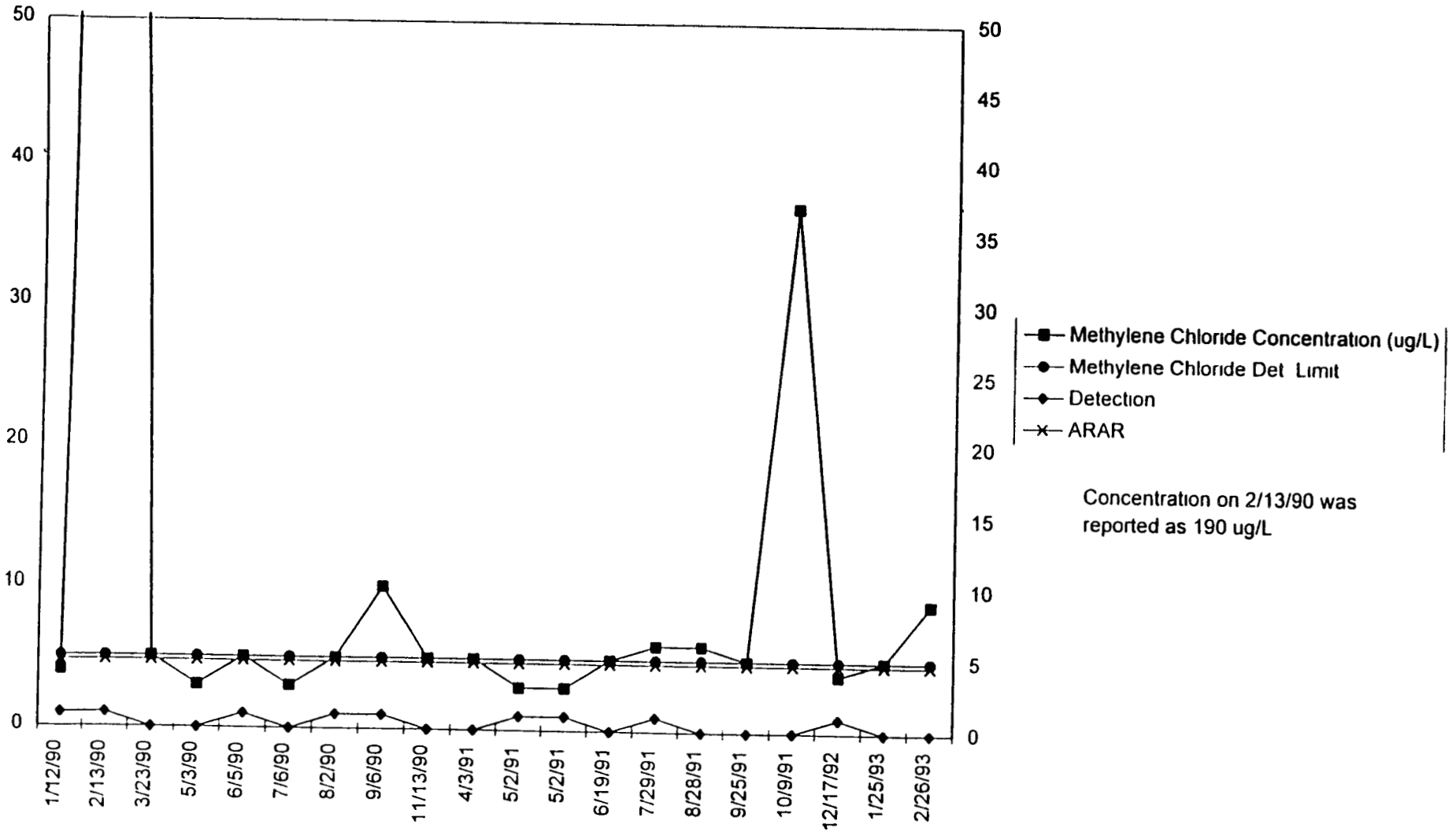
Figure 6
Benzene Concentrations Over Time



7/11/95

ALUM41 XLS

Figure 7
Methylene Chloride Concentrations Over Time



Concentration on 2/13/90 was reported as 190 ug/L

Figure 8
Vinyl Chloride Concentrations Over Time

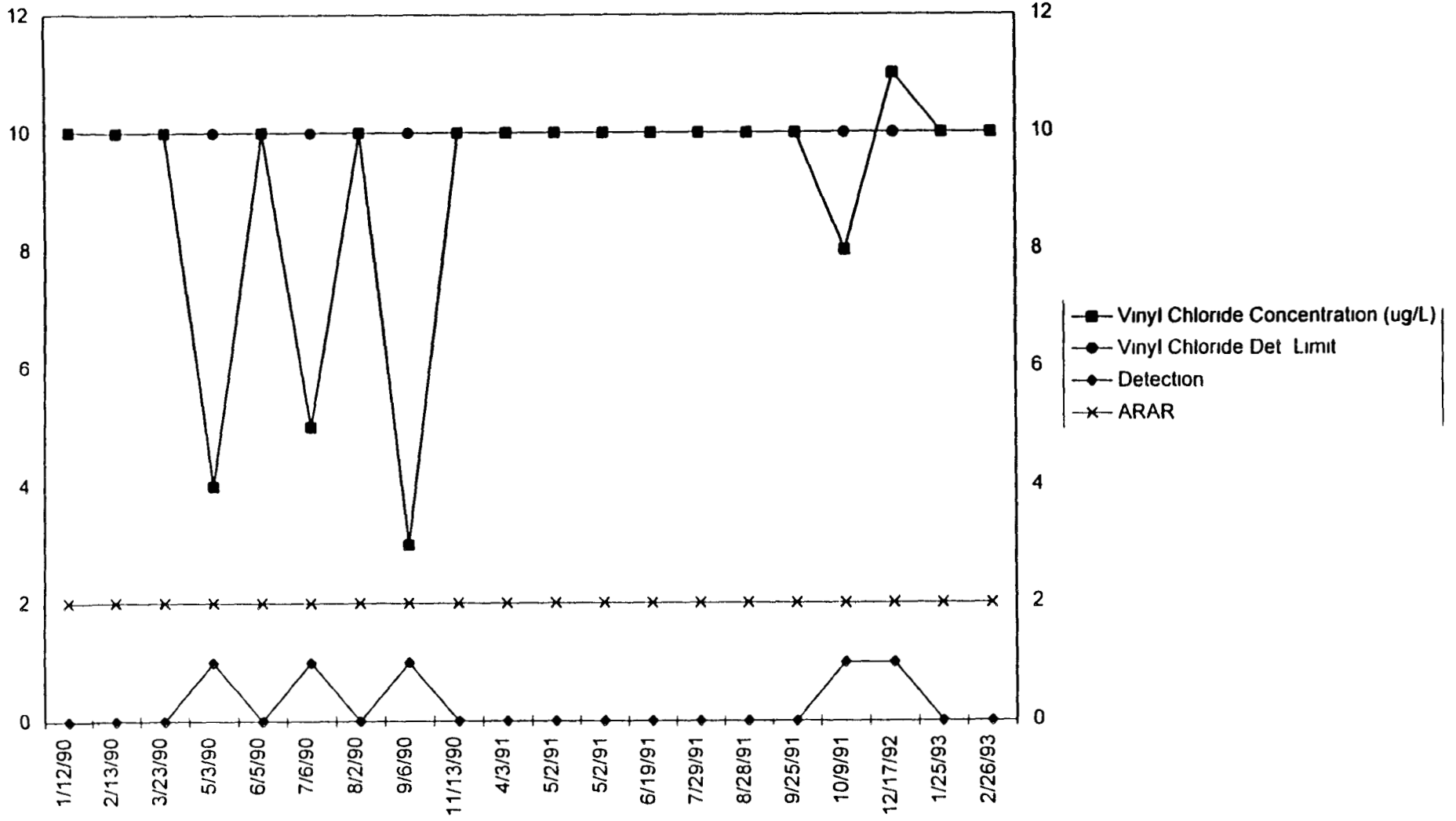
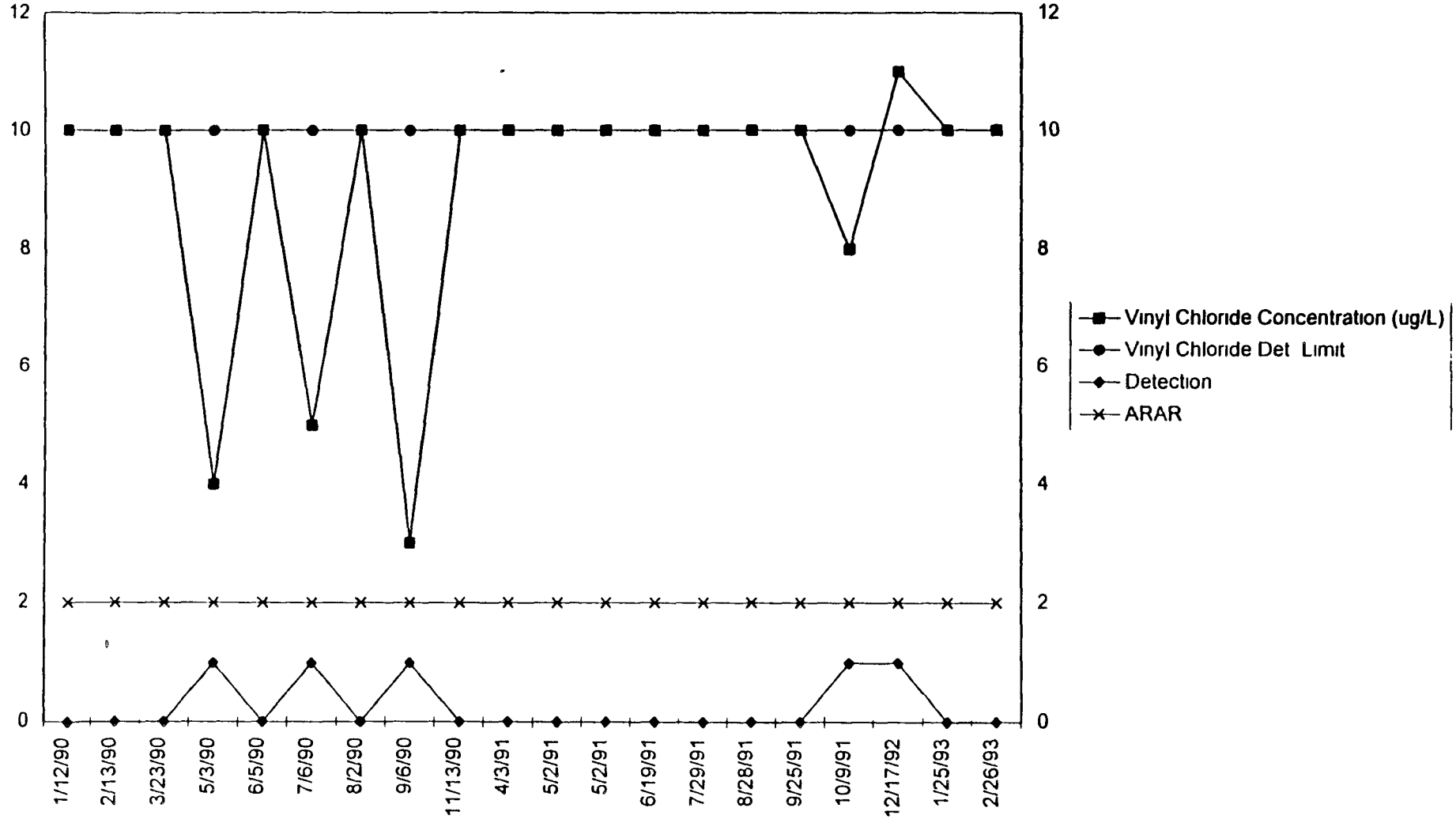


Figure 9
Vinyl Chloride Concentrations Over Time



2. Product Specification Sheets for Bag Filters

Bag filter shall be Rosedale 82-30-2P-2-150-N-S-D-B-S-B

Where

- 82 = Model 82
- 30 = 30-inch housing
- 2P = 2-inch FPT inlet and outlet
- 2 = side outlet
- 150 = 150 psi
- N = No ASME code stamp
- S = 304 stainless steel
- D = displacer
- B = Buna N cover gasket
- S = basket seal (required)
- B = filter bag basket (filter bags shall be 10 micron or 20 micron)

HOW TO ORDER:

Build an ordering code as shown in the example.

EXAMPLE: 82 - 30 - 4F - 2 - 150 - N - C - N - B - S - BM - 20

MODEL 82 = 82

HOUSING SIZE
15 inch = 15
30 inch = 30

PIPE SIZE, NPT & FLANGED 2P
2-in. 150 or 300-lb ANSI flange* = 2F
3-in. 150 or 300-lb ANSI flange* = 3F
4-in 150 or 300-lb ANSI flange* = 4F
6-in. 150 or 300-lb ANSI flange* = 6F
*Dependent on required pressure rating

OUTLET STYLE
Side = 2

PRESSURE RATING[1]
150 psi = 150
300 psi = 300

ASME CODE STAMP
None = N
CODE = C

HOUSING MATERIAL
Carbon steel = C
304 stainless steel = S
316 stainless steel = 316S

DISPLACER
No displacer = N
Displacer = D

COVER GASKET
Buna N = B
Ethylene Propylene = E
Viton Fluoroelastomer = V
Teflon Fluorocarbon Resin = T

BASKET SEAL
Seal (required) = S

BASKET TYPE
Filter bag basket[2] = B
Strainer basket = P
Filter bag basket, mesh lined[2] = BM
Strainer basket, mesh lined = M
Filter bag basket, heavy wire mesh = HWM
Pleated bag basket[2] = PB

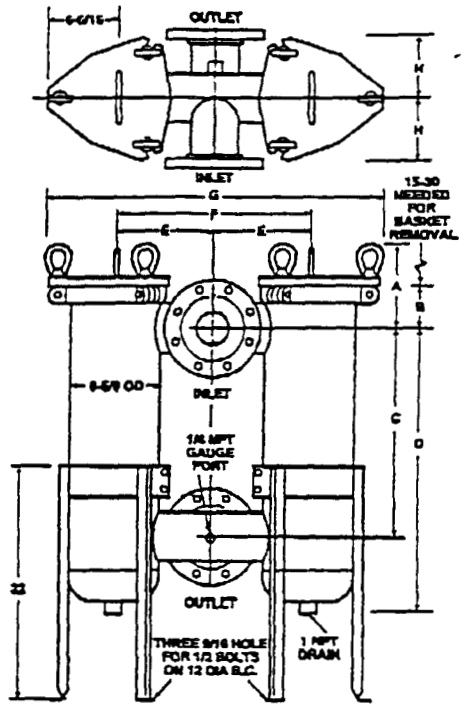
BASKET, MEDIA SIZE, no symbol if type B basket was selected

Type P perforation diameters
1/4, 3/16, 9/64, 3/32, 1/16

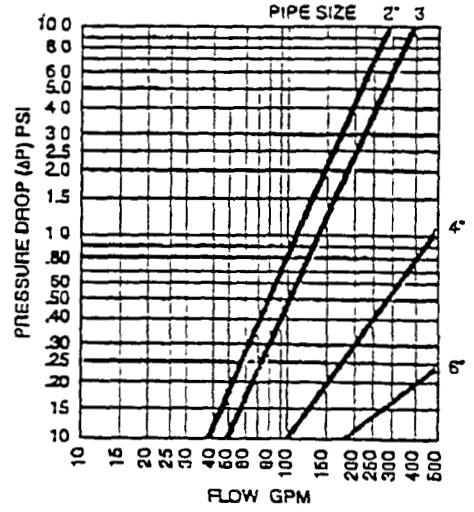
Type M and BM mesh sizes
20, 30, 40, 50, 60, 70, 80, 100, 150, 200 = 200

1 Higher pressures are available, consult factory
2. Filter bags are specified separately
See Rosedale Filter bag Catalogs FB PLTD BETA GD HI-E

DIMENSIONS (IN.)



Pipe Size	2	3	4	6
A	6-5/8	7-1/2	7-1/2	9
B	2-7/8	3-3/4	3-3/4	5-1/4
C (15 in)	14-1/2	14-1/2	14-1/2	14-1/2
(30 in)	29-1/2	29-1/2	29-1/2	29-1/2
D (15 in)	21-3/16	22-3/32	22 3/32	23-9/16
(30 in)	36-3/16	37-3/32	37 3/32	38-9/16
E	8	8	9	9
F	16	16	18	18
G	28-9/16	28 9/16	30 9/16	30-9/16
H	4-1/2	5 1/2	6-1/2	8



BASKET DATA (each basket, two baskets total)

Depth Inches (nominal)	Diameter (inches)	Surface Area (sq. ft.)	Volume (cu. in.)	Bag Size No.
25	6.7	2.3	500	1
30	6.7	4.4	1000	2

*Based on housing only. Fluid viscosity, filter bag used and expected dirt loading should be considered when sizing a filter

ROSEDALE PRODUCTS, INC.
P.O. Box 1085 Ann Arbor, MI 48106
Tel 800-821-5373 or 313-665-8201
Fax 313-665-2214

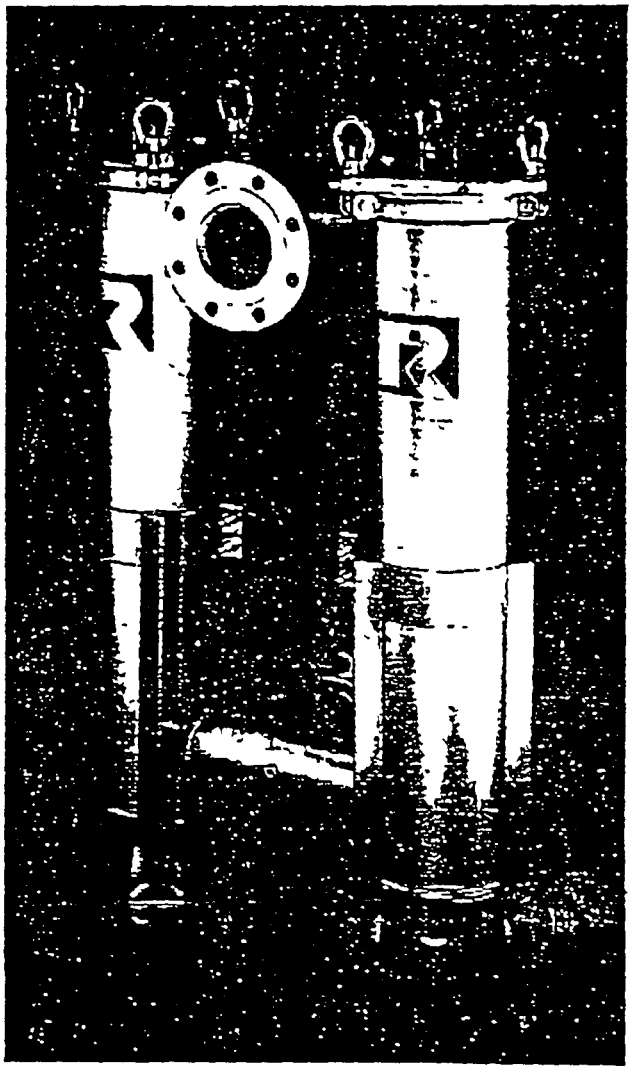
NEW

ROSEDALE

DUAL CAPACITY BAG FILTER AND BASKET STRAINER

Extra capacity at higher flow rates!

Rosedale dual capacity housings can serve as either basket strainers or bag filters Covers are easily removed, without tools, and the basket or bag is quickly and easily cleaned or replaced. Rosedale's bag-sized pleated cartridges will provide even greater dirt-holding capacity (see Catalog PLTD-100).
Low price, greater dirt holding capacity, and higher flow rates make the Model 82 a very cost-efficient choice!



FEATURES

- For flow rates to 440 gpm
- Large-area, heavy-duty baskets
- Dual stage straining/filtering
- Low pressure drops
- Permanently-piped housings
- Covers are O-ring sealed
- Carbon steel or stainless steel (304 or 316) housings
- Housings are electropolished to resist adhesion of dirt or scale
- Adjustable-height legs
- ASME code stamp available
- Liquid displacers for easier servicing
- Special options include sanitary construction, higher pressure ratings, extra-length legs, and heat jacketing

FILTRATION PRODUCTS - OUR ONLY BUSINESS

Rosedale Products Inc.

103

Strainers or Bag Filters: Your Choice!

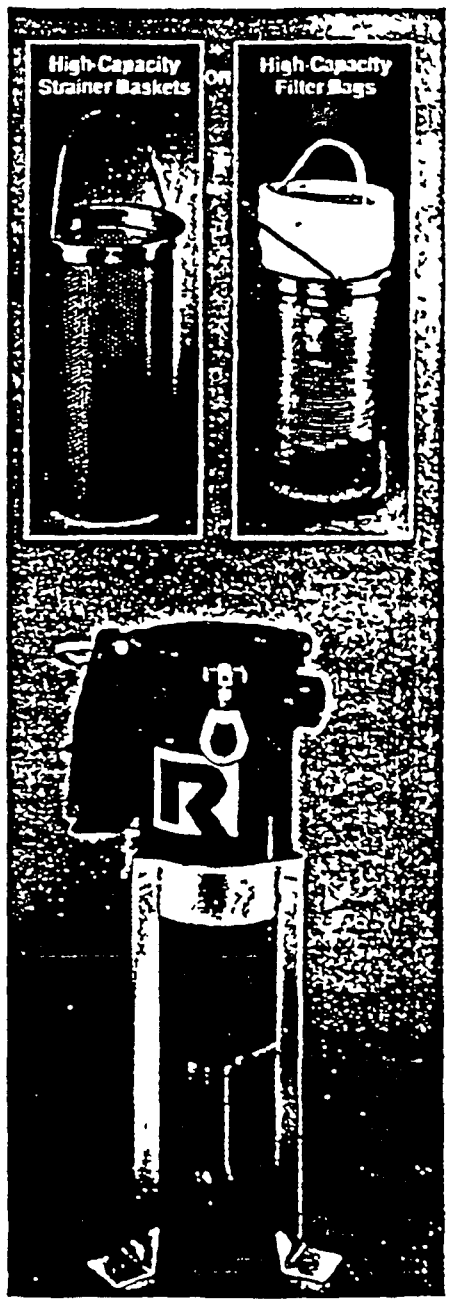
Rosedale strainer/filter housings are made in many sizes, and all can serve as basket strainers (for particle retention down to 74 micron size) or as bag filters (for particle retention down to 1 micron size). In all cases, covers are easily removed, without tools, and the basket or bag is easily cleaned or replaced.

FEATURES

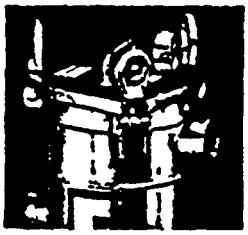
- Large-area, heavy-duty baskets
- Low pressure drops
- Housings are permanently piped
- Covers are O-ring sealed
- Carbon steel, or stainless steel (304 or 316) housings
- All housings are electropolished to resist adhesion of dirt and scale
- Adjustable-height legs, standard on Models 6 and 8, optional extra on Model 4
- Easy to clean
- ASME code stamp for 150 or 300 psi
- Liquid displacers for easier servicing
- Special options include filter bag hold-down devices, sanitary construction, different outlet connections, higher pressure ratings, extra-length legs, heat jacketing, and adapters for holding filter cartridges
- Multiple-basket and duplex units are available

Dual Stage Straining/ Filtering

All Rosedale Model 8 housings can be supplied with a second, inner basket which is supported on the top flange of the regular basket. Both baskets can be strainers (with or without wire mesh linings) or both can be baskets for filter bags. They can also be mixed, one a strainer basket, the other a filter bag basket. Dual-stage action will increase strainer or filter life and reduce servicing needs.



Covers are secured by three eyenut assemblies. One of them acts as a hinge when cover is opened. Model 4 units can also be ordered with a lighter cover, held in place with a single quick-opening clamp (photo on cover).



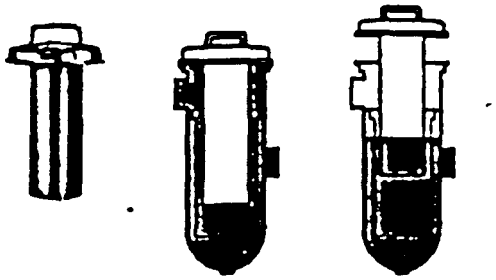
MULTI-BASKET MODELS

Larger units with multiple baskets (from 2 to 17) are also made. They can handle flows from 400 to 3500 gpm. Ask for Catalog MB.

DUPLEX MODELS

Most of the models described here are also available as duplex systems. Two units come piped together with valves to permit continuous use of either unit while servicing the other. One lever actuates all valves simultaneously. Ask for Catalog DF.

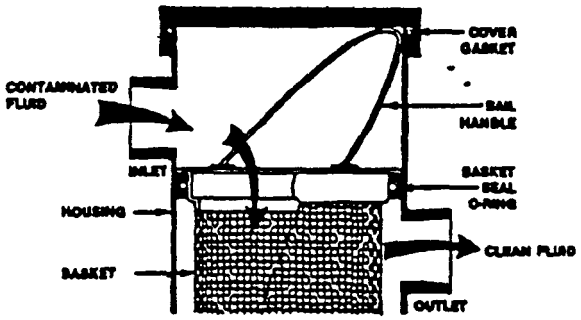
Liquid Displacer Option



All strainers or filters can be supplied with a liquid displacer. When in use the displacer (a sealed 304 stainless steel cylinder) is inside the strainer basket or filter bag, displacing liquid that would otherwise fill the inner space When the cover and displacer are removed, the level of liquid within the strainer basket or filter bag is lowered which results in less product loss, and fast, easy changes.

If the weight of the cover-displacer assembly is a concern (the heaviest, on a Model 8-30, is 20 pounds) you can easily detach the displacer

Operation



Unfiltered liquid enters the housing above the bag or basket and passes down through them. Solids are contained inside the bag or basket where they're easily and completely removed when the unit is serviced. A hinged basket ball is pushed down by the closed cover, to hold the basket against a positive s p in the housing. It helps prevent bypassing of unfiltered liquid.

Fluid bypass around the basket is prevented by an optional O-ring seal between the basket rim and the housing ID. This seal is required on Model 8 bag filters. Model 4 and 6 bag filters don't need this O-ring because the OD of the filter bag seals against the housing itself, rather than against the ID of the basket rim

A single cover gasket is used to seal the opening, and covers can be installed and removed without tools.

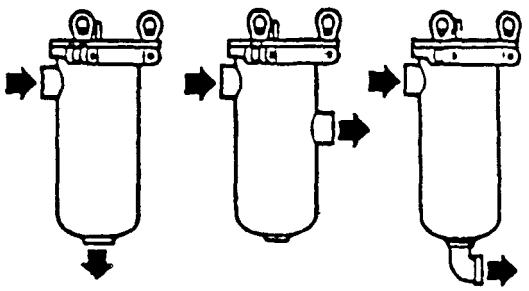
Construction Materials

All housings and other wetted parts not otherwise specified can be ordered in carbon steel 304 stainless steel, or 316 stainless steel.

Four different materials can be ordered for all seals involved

All baskets and mesh linings are made of stainless steel 304 stainless will be supplied with carbon and 304 housings, 316 stainless with 316 housings.

Convenient Piping Arrangements



Style 1 Bottom outlet | Style 2 Side outlet | Style 3 Bottom outlet with elbow

Many basket options

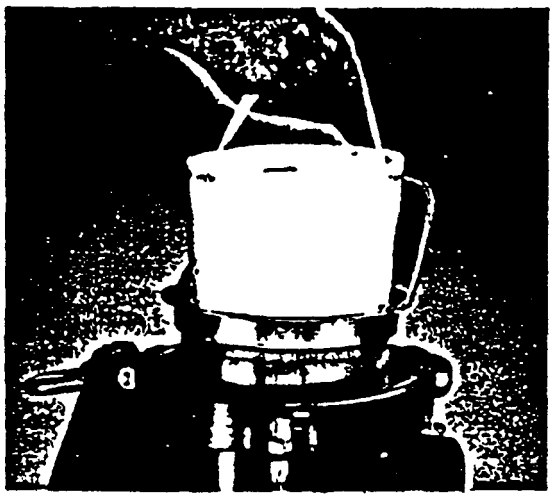
The baskets offered will permit the straining and filtering of a wide variety of fluids, to retain solids of almost any size.

All baskets are easily removed and cleaned. All are made in depths to suit the housing selected.

Plain perforated strainer basket.
Choose from the following perforation sizes: 1/4, 3/16, 9/64, 3/32, and 1/16 inch.

Perforated strainer basket with wire mesh linings.
High quality wire is used, in mesh sizes 20, 30, 40, 50, 60, 70, 90, 100, 150, and 200.

Filter bag basket.
They have 9/64-in.-diameter perforations, for a 51 percent open area. They accept standard size filter bags (see Rosedale Catalog FB)



Choosing a basket strainer or bag filter

Once the choice between straining a fluid (removing particles down to 74 micron size) and filtering it (removing particles down to one micron) has been made, the choice of which size Rosedale model must be made. All three models (4, 6, and 8) and the baskets and bags that go in them, are of the same basic design. They differ in dimensions, capacities, maximum pressure ratings, and pipe size. Selection is based on these variables.

PRESSURE DROP DATA
Basket strainers and bag filters are usually selected so that the pressure drop does not exceed 2 psi, when they are clean. Higher pressure drops may be tolerated when contaminant loading is low.

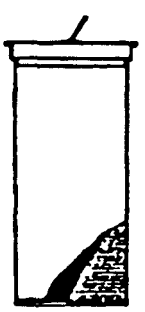
The pressure drop data is accurate for all housings with strainer or filter bag baskets. When filter bags are added, total pressure drop becomes the sum of the pressure drop as determined by the steps below plus the pressure drop through the bag as defined in Rosedale Filter Bag Catalog FB.

Follow these easy steps:

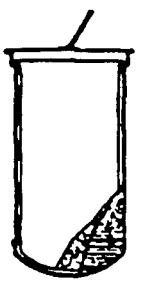
1. Using the desired pipe size and approximate flow rate, determine the basic pressure drop from the appropriate graph
2. Multiply the pressure drop obtained in step 1 by the viscosity correction factor found in the accompanying table. This is the adjusted (clean) pressure drop for all baskets, without filter bags.

	Viscosity cps								
	1 (H$_2$O)	50	100	200	400	600	800	1000	2000
All solved baskets	.85	.85	1.00	1.10	1.20	1.40	1.50	1.60	1.80
40-mesh lined	.73	.95	1.20	1.40	1.50	1.80	1.90	2.00	2.30
60-mesh lined	.77	1.00	1.30	1.60	1.70	2.10	2.20	2.30	2.80
80-mesh lined	.83	1.20	1.50	1.90	2.10	2.40	2.60	2.80	3.50
100-mesh lined	1.00	1.30	1.60	2.20	2.40	2.70	3.00	3.30	4.40
200-mesh lined	1.30	1.70	2.10	3.00	3.40	3.90	4.40	5.00	6.80

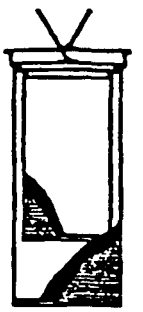
SINGLE-STAGE BASKETS
(all models)



Single-stage perforated strainer basket, with or without wire mesh liner.

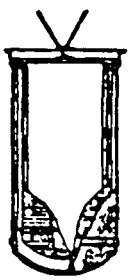


Single-stage filter bag, within perforated basket. Can also be wire mesh lined, or be made entirely of heavy wire mesh

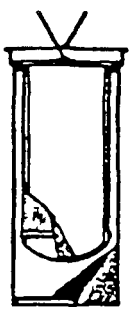


Dual-stage straining can be done with two perforated strainer baskets, with or without wire mesh linings.

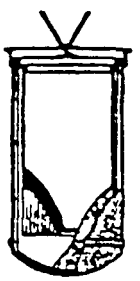
TWO-STAGE BASKETS
(Model 8 only)



Both inner and outer filter bags in this dual-stage configuration can be of the throw-away or cleanable type.



A filter bag within a wire mesh-lined outer basket. Mesh is backstop if bag ruptures or is missing.



A perforated strainer basket (with or without wire mesh lining) inside a filter bag gives effective dual-stage straining-filtering

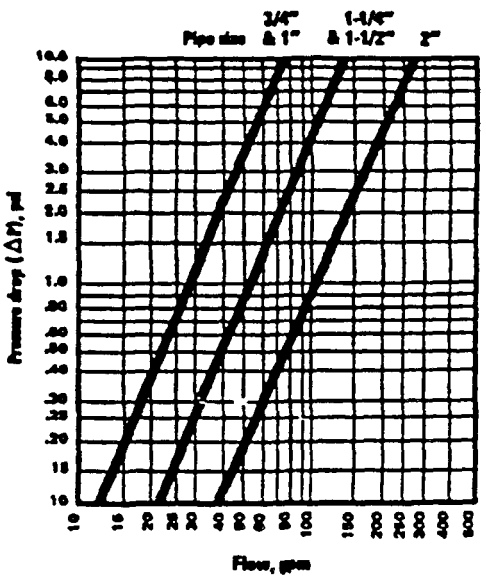
The following model descriptions and flow tables can be used to aid in selection, and make comparisons between the various styles.

Model 4—For flow rates to 50 gpm

- Pipe sizes 3/4 thru 3-inch, NPT or flanged
- Two basket depths: 6 or 12 inches (nominal)
- Three pressure ratings: 200 psi (with clamp cover) and 300 or 500 psi (with eyenut cover)
- ASME code stamp available

BASKET DATA

Depth Nominal (inches)	Diameter (inches)	Surface Area (sq. ft.)	Volume (cu. in.)
6	3.9	0.5	65
12	3.9	1.0	130

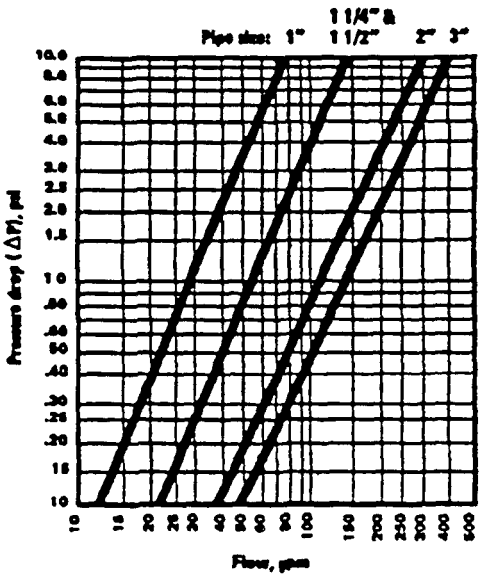


Model 6—For flow rates to 100 gpm

- Delivers 3.4 square feet of basket or bag surface area without need for ASME code construction
- Can be fitted with cartridge filter element adapter
- Pipe sizes 3/4 thru 4-inch, NPT or flanged
- Three basket depths: 12, 18 or 30 inches (nominal)
- Two pressure ratings: 150 psi or 300 psi
- ASME code stamp available

BASKET DATA

Depth Nominal (inches)	Diameter (inches)	Surface Area (sq. ft.)	Volume (cu. in.)
12	5	1.3	235
18	5	2.0	350
30	5	3.4	630

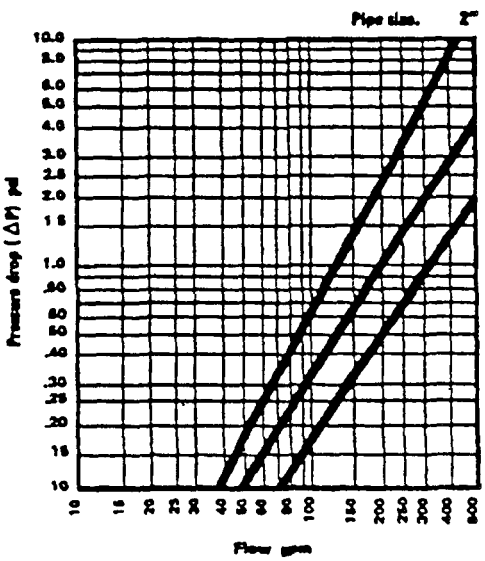


Model 8—For flow rates to 220 gpm

- Can be fitted with an adapter to hold cartridge filter elements
- Pipe sizes 3/4 thru 4-inch, NPT or flanged
- Two basket depths. 15 or 30 inches (nominal)
- Two pressure ratings: 150 or 300 psi
- ASME code stamp available.

BASKET DATA

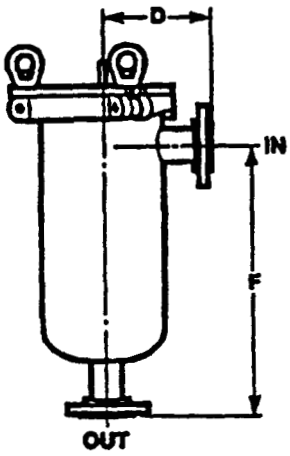
Depth Nominal (inches)	Diameter (inches)	Surface Area (sq. ft.)	Volume (cu. in.)
15	6.7	2.3	500
30	6.7	4.4	1000

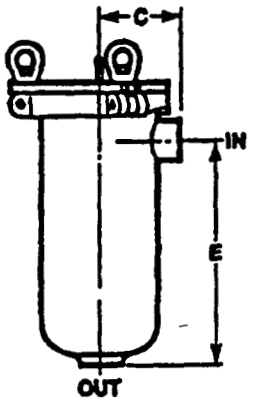


OUTLET STYLES

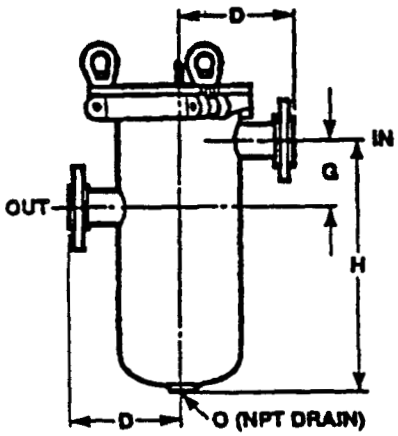
FLANGED (150 lb. ANSI) THREADED (NPT)

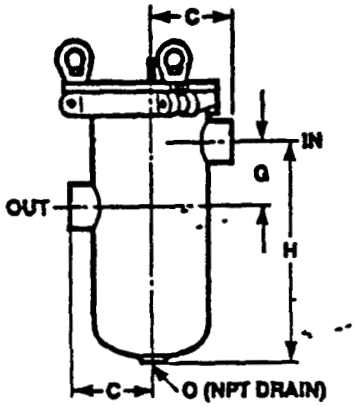
STYLE 1



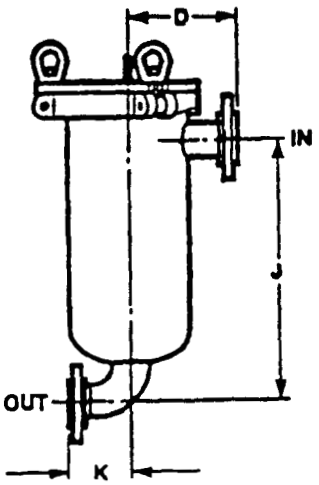


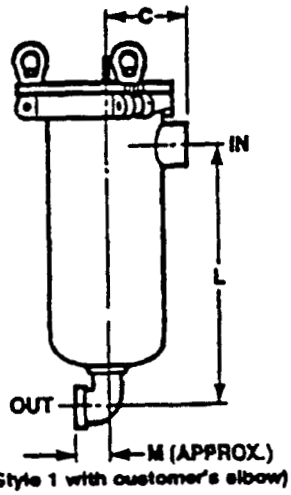
STYLE 2





STYLE 3

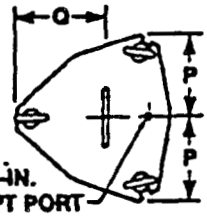


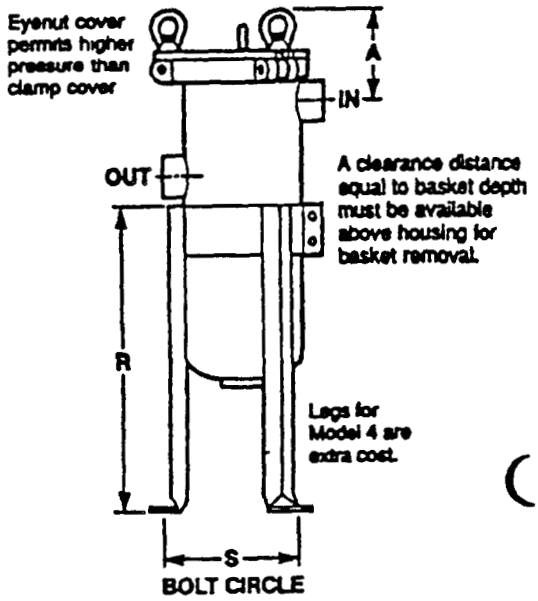


(Style 1 with customer's elbow)

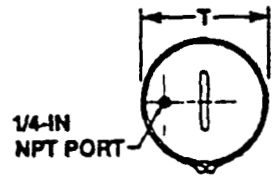
COVER TYPES

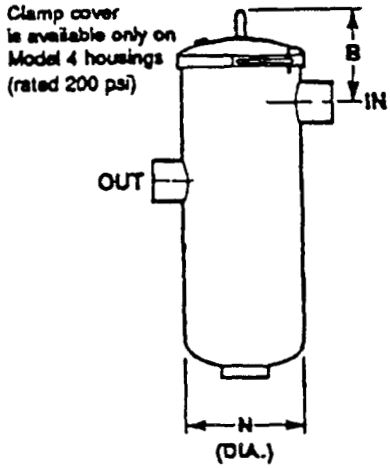
EYENUT COVER





CLAMP COVER





DIMENSIONS (IN.)

Model	Pipe Size	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
4-8	3/4	5.5	5.2	3.5	5.0	10.1	12.0	3.0	10.1	10.4	4.0	11.2	1.3	4.5	1/2	3.5	3.6	14.0	6.8	5.6
	1	5.5	5.2	3.5	5.0	10.1	12.0	3.0	10.1	10.9	4.0	11.5	1.5							
	1-1/4	6.0	5.8	3.5	5.0	9.4	12.0	4.3	9.5	10.5	4.0	11.1	1.8							
	1-1/2	6.0	5.8	3.5	5.0	9.3	12.0	4.3	9.5	10.8	4.0	11.3	2.0							
	2	6.0	5.8	3.5	5.0	9.3	12.0	4.3	9.5	11.6	4.0	11.8	2.3							
4-12	3/4	5.5	5.2	3.5	5.0	16.1	18.0	3.0	16.1	16.4	4.0	17.2	1.3	4.5	1/2	3.5	3.6	14.0	6.8	5.6
	1	5.5	5.2	3.5	5.0	16.1	18.0	3.0	16.1	16.9	4.0	17.5	1.5							
	1-1/4	6.0	5.8	3.5	5.0	15.4	18.0	4.3	15.5	16.5	4.0	17.1	1.8							
	1-1/2	6.0	5.8	3.5	5.0	15.3	18.0	4.3	15.5	16.8	4.0	17.3	2.0							
	2	6.0	5.8	3.5	5.0	15.3	18.0	4.3	15.5	17.6	4.0	17.8	2.3							
8-12	1	6.1		4.3	6.0	17.3	19.8	4.3	17.3	18.1	5.0	18.6	1.5	6.0	3/4	5.0	5.3	18.0	9.5	
	1-1/4	6.1		4.3	6.0	17.3	19.8	4.8	17.3	18.4	5.0	19.0	1.8							
	1-1/2	6.1	N/A	4.3	6.0	17.3	19.8	4.8	17.3	18.8	5.0	19.3	2.0							N/A
	2	6.1		4.3	6.0	17.2	19.7	4.8	17.3	19.6	5.0	19.7	2.3							
	3	7.0		4.3	6.0	18.2	20.7	6.6	18.2	22.0	4.8	21.9	3.1							
8-18	1	6.1		4.3	6.0	23.3	25.8	4.3	23.3	24.1	5.0	24.6	1.5	6.0	3/4	5.0	5.3	18.0	9.5	
	1-1/4	6.1		4.3	6.0	23.3	25.8	4.8	23.3	24.4	5.0	25.0	1.8							
	1-1/2	6.1	N/A	4.3	6.0	23.3	25.8	4.8	23.3	24.8	5.0	25.3	2.0							N/A
	2	6.1		4.3	6.0	23.2	25.7	4.8	23.3	25.6	5.0	25.7	2.3							
	3	7.0		4.3	6.0	24.2	26.7	6.6	24.2	28.0	4.8	27.9	3.1							
8-30	1	5.5		4.3	6.0	35.3	37.8	4.3	35.3	36.1	5.0	36.6	1.5	6.0	3/4	5.0	5.3	18.0	9.5	
	1-1/4	6.0		4.3	6.0	35.3	37.8	4.8	35.3	36.4	5.0	37.0	1.8							
	1-1/2	6.1	N/A	4.3	6.0	35.3	37.8	4.8	35.3	36.8	5.0	37.3	2.0							N/A
	2	6.1		4.3	6.0	35.2	37.7	4.8	35.3	37.6	5.0	37.7	2.3							
	3	7.0		4.3	6.0	36.2	38.7	6.6	36.2	40.0	4.8	39.9	3.1							
8-15	2	6.6		5.9	7.5	20.9	23.5	4.8	21.0	23.2	3.3	23.1	2.3	8.6	1	5.8	6.3	22.0	12.0	
	3	7.4	N/A	6.8	7.5	21.7	24.6	6.6	21.9	25.5	4.8	25.9	3.1							N/A
	4	7.4		6.8	8.6	21.5	25.1	8.4	21.9	26.8	6.3	27.6	3.8							
8-30	2	6.6		5.9	7.5	35.9	38.5	4.8	36.0	38.2	3.3	38.1	2.3	8.6	1	5.8	6.3	22.0	12.0	
	3	7.4	N/A	6.8	7.5	36.7	39.6	6.6	36.9	40.5	4.8	40.9	3.1							N/A
	4	7.4		6.8	8.6	36.5	40.1	8.4	36.9	41.8	6.3	42.6	3.8							

HOW TO ORDER

Build an ordering code as shown in the example. Each option is available only on the model sizes indicated in the colored blocks preceding its description.

Key to blocks: = Model 4, = Model 6, = Model 8

EXAMPLE: 8 15 3P 1 150 N C D B S – M 200 – 2M 50

(HOUSING; BASKET; OPTIONAL INNER BASKET)

MODEL NO.

4 = 4
6 = 6
8 = 8

HOUSING SIZE

6 in. = 6
12 in. = 12
15 in. = 15
18 in. = 18
30 in. = 30

PIPE SIZE, NPT & FLANGED[1]

3/4-in. female NPT = 3/4P
1 in. female NPT = 1P
1-1/4-in. female NPT = 1-1/4P
1-1/2-in. female NPT = 1-1/2P
2-in. female NPT = 2P
3-in. female NPT = 3P
3/4-in. 150-lb. ANSI flange = 3/4F
1 in. 150-lb ANSI flange = 1F
1-1/4-in. 150-lb ANSI flange = 1-1/4F
1-1/2-in. 150-lb ANSI flange = 1-1/2F
2-in. 150-lb ANSI flange = 2F
3-in. 150-lb ANSI flange = 3F
4-in 150-lb ANSI flange = 4F
6-in 150-lb ANSI flange = 6F

OUTLET STYLE

Bottom = 1
Side = 2
Bottom elbow = 3

PRESSURE RATING[2]

300 psi = 300
500 psi = 500
200 psi (clamp cover) = 200
150 psi = 150
210 psi = 210

ASME CODE STAMP

None = N
Code = UM

HOUSING MATERIAL

Carbon steel = C
304 stainless steel = S
316 stainless steel = 316

FOR MODEL 8 ONLY

OPTIONAL INNER BASKET, MEDIA SIZE
No symbol if type 2B basket was selected

Perforation diameters (for type 2P baskets)
1/4, 3/16, 9/64, 3/32, 1/16
Mesh sizes (for type 2M and 2BM baskets)
20, 30, 40, 50, 60, 70, 80, 100, 150, 200

OPTIONAL INNER BASKET TYPE

2B = Filter bag basket, 9/64 perforations[3]
2P = Strainer basket, perforated metal
2BM = Filter bag basket, perforated mesh lined[3]
2M = Strainer basket, perforated, mesh lined

BASKET, MEDIA SIZE
No symbol if type B basket was selected

Perforation diameters (for type P baskets)
1/4 3/16, 9/64 3/32 1/16
Mesh sizes (for type M and BM baskets)
20 30, 40, 50, 60 70, 80, 100, 150, 200

BASKET TYPE

B = Filter bag basket, 9/64 perforations[3]
P = Strainer basket, perforated metal
BM = Filter bag basket, perforated, mesh lined[3]
M = Strainer basket, perforated, mesh lined
HWM = Filter bag basket, heavy wire mesh[3]

BASKET SEAL

N = No seal (never on Models 4 & 6 bag type baskets)
S = Seal required (always on Model 8 bag-type baskets)

COVER GASKET

B = Buna N
E = Ethylene Propylene
V = Viton Fluoroelastomer
T = Teflon Fluorocarbon Resin

DISPLACER

N = No displacer
D = Displacer

1 ANSI 150-lb RLF flanges provided as standard. Other styles and classes available. ANSI B16.5 Pressure-Temperature rating tables determine flange class for ASME code housings. Consult factory

2. Higher pressure ratings available. Consult factory
3. Filter bags are specified separately See Rosedale Filter Bag Catalog FB.

ROSEDALE PRODUCTS, INC.
Box 1085, Ann Arbor, MI 48106
Tel 313-665-8201 Fax. 313-665-2214

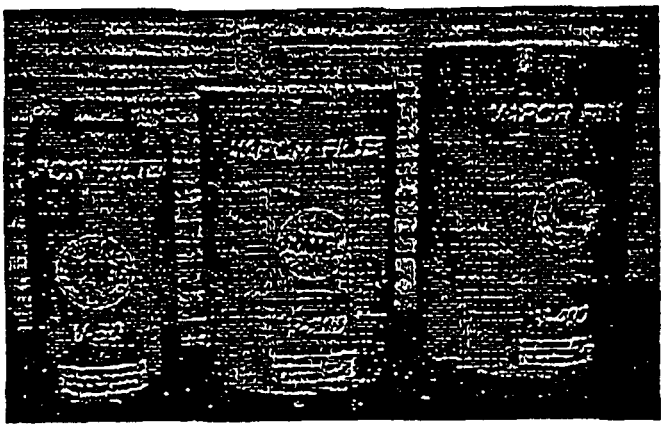
Catalog 468-3 12M4/90 Litho in USA

3. Product Specification Sheets for Granular Activated Carbon Drum Filters

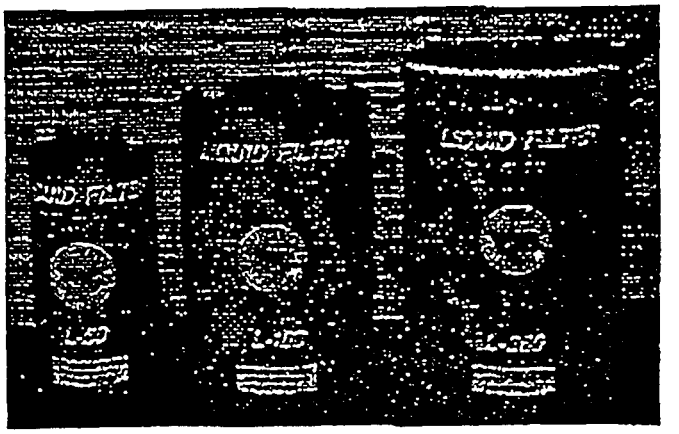
PRODUCT BULLETIN

DISPOSABLE DRUM FILTERS

VAPOR PHASE



LIQUID PHASE



The NWC line of disposable adsorption drum filters are constructed of heavy duty steel or rugged Poly casings Activated carbons by NWC are effective and economical in the removal of organic contaminants for both liquid and vapor phase applications Each canister is D O T approved as a transport container to TSD facilities for regeneration/disposal Uses include small spills, pilot and step tests, low volume pump and treat, discharge permit compliance, small remediation projects, emergency response, mobile units standby preparedness and many others NWC provides complete pick-up and disposal services

V-50	V-200	V-400	SPECIFICATIONS	L-50	L-180	L-360
12 PSI	12 PSI	12 PSI	Working Pressure, Max	12 PSI	12 PSI	12 PSI
75 CFM	100 CFM	300 CFM	Flow Rate, Max	7 GPM	10 GPM	20 GPM
<15"	<15"	<15"	Δ P (In H_2O @ 70 °F)	<10"	<5'	<15"
No	Yes	Yes	Steel Casing	No	Yes	Yes
Yes	Yes	No	Poly Casing	Yes	Yes	No
N/A	Epoxy	Epoxy	Lining (Steel)	N/A	Epoxy	Epoxy
50 lb	200 lb	320 lb	Carbon Fill Volume	50 lb	180 lb	360 lb
2" NPT	2" NPT	4" NPT	In/Out Connections	2" NPT	2" NPT	2" NPT
22"	36"	38"	Height	28"	36"	38"
16"	24"	27"	Diameter	16"	24"	27"
57 lb	250 lb	420 lb	Shipping Weight (dry)	58 lb	230 lb	420 lb
114 lb	500 lb	920 lb	Shipping Weight (Wet)	116 lb	460 lb	840 lb

RED BLUFF P O Box 130 Red Bluff CA 96080-0130 Tel 916-527-2664 Fax 916-527-0544
IRVINE 1702 Kaiser Ave Irvine CA 92714-5706 Tel 714-252-8555 Fax 714-252-8554
ATLANTA P O Box 44[illegible]

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6/20/95

S.M. STAHLER
PROJECT:
PROJECT LOCATION COLORADO
ATTN: GREG MEEKER

THE FOLLOWING DATA HAS BEEN GENERATED BY THEORETICAL LIQUID PHASE ADSORPTION ISOTHERM PREDICTION. THE CARBON CAPACITIES (TO SATURATION) HAVE BEEN USED TO COMPUTE THE CARBON EXHAUSTION RATE IN LB/24 HR DAY FOR A SYSTEM AT 70F 760 mm Hg USING A CARBON WITH A PORE VOLUME OF 0.70 ml/g.

THE FLOW RATE IS 5 GPM

COMPOUND	K	1/N	PPM	% SORP	CARBON LB/24 HR
CHLORETHANE	0.590	0.950	0.022	0.002	84.03
VINYLCHLORIDE	0.590	0.950	0.006	0.000	78.74
NAPHTHALENE	132.000	0.420	0.018	2.442	0.(
1,1 DCA	1.790	0.530	0.006	0 012	3.(
BENZENE	3.300	0.430	0 002	0 023	0.53
				TOTAL AMOUNT OF CARBON USED IN 24 HR	166 367

IF YOU HAVE ANY QUESTIONS PLEASE GIVE ME A CALL

BEST REGARDS,

S/C: 28-32 lb/ft³

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4. Design Calculations for Head Loss in Pipes

OU 7 Passive Collection and Treatment System Head Loss				
Flow rate, Q, gpm	5			
Pipe inner diameter (inches)	2			
Roughness Coefficient, C	140			
Length of pipe in System, not including filters or GAC drums				
	Each	Equivalence in Feet (ft/each)	Feet	
Double containment pipe, straight (ft)			12	
Flexible Pipe (ft)			24	
Single containment pipe, straight (ft)			10	
45 deg Elbows	2	4 3	8 6	Asahi/America, Inc Engineering Design Guide
Equivalent 90 deg Elbows (each bend in flexible pipe figured as 90 deg elbow)	13	10	130	Asahi/America Inc Engineering Design Guide
Tee, straight flow	4	3	12	Asahi/America, Inc Engineering Design Guide
Ball Valve	1	1	1	
Total Equivalent Length of 2" Pipe (ft)			197 6	
Hazen and Williams Formula				
Head Loss, $h_f = 0\ 2083 * (100/C)^{1.85} * (q^{1.85} / d^{4.87})$				
Where				
h_f = head loss due to friction (ft of water / 100 ft of pipe)				
C = roughness coefficient				
q = flow rate (gpm)				
d = inside diameter of pipe (inches)				
Head Loss per 100 ft, h_f (ft) in 2-inch pipe	0 075064	per 100 ft		
Head Loss, h_f (ft) in 2-inch pipe	0 148			
Head Loss in GAC Drum (2 inch/drum)	0 500	Telephone conversation, Northwestern Carbon, (714)252-8555 (David Herman), 6/23/95		
Head Loss in Clean Filter (0 1 psi)	0 231	Telephone conversation Northwestern Carbon, (714)252-8555 (David Herman) 6/23/95		
Total Head Loss in System (clean) (feet)	0 879			

5. Assumed Soil Loadings

MEMORANDUM

To: Project File

From: Kieth Fiebig, S.M. Stoller

Subject: Assumed Soil Loadings for Seep Collection and Treatment System, OU7 RFETS

Date: September 12, 1995

We do not have actual field geotechnical data for site conditions; however, we are assuming field conditions.

- Active Lateral Earth Pressure	52 pcf
- Surcharge from hillside, construction and operational loads	125 psf
- Soil Compacted Dry Unit Weight	105 pcf
- Soil Compacted Wet Unit Weight	120 pcf

Attached are the calculations for the active earth pressure.

References:

Foundation Engineering Handbook, edited by Hsai-Yang Fang, 2nd Edition, 1990

Stoller

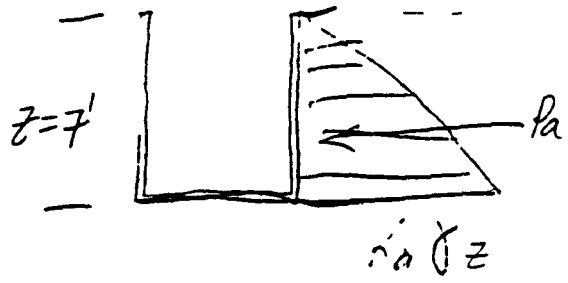
JOB NO _____ DATE _____

JOB NAME _____

PREPARED _____ REVIEWED _____

SHEET NO _____ OF _____

Active lateral Earth pressures



$c = 105 pcf$

coeff. for active earth press. $K_a = 0.49$ (Table 6.2) for Compacted Silt

$\phi = 20°$

level earth slope $\psi = 0$

vertical wall $\beta = 0$

$c = 0$

$P_a = \frac{1}{2} \gamma z^2 K_a = .49 \times 105 \times \frac{7}{2}$

$= 360 psf$

$P_a = 1260 pff$

or

51.5 pcf

$P_h = \gamma_{eq} z + K q_s = 420 + 50 = 470 psf$

or

67 pcf equivalent fluid unit weight

$\gamma_{eq} = 60 pcf$ (compacted silt)

$z = 7'$

$K = 0.5$ (level backfill)

$q_s = 100 psf$ (surcharge pressure)

References:

Foundation Engineering Handbook, 2nd Ed., edited by Hsai-Yang Fang, 1990

WB

6 1 AT-REST LATERAL PRESSURES

At-rest pressures exist in level ground, and develop under long-term conditions as the soil is deposited and acted upon by changes in the loading environment as caused by erosion, glaciers, and physicochemical processes At-rest pressures rigorously only apply for walls that are placed into the ground with a minimum of disturbance and that remain unmoved during loading, or for unmoving, frictionless walls with a backfill placed with a minimum of compactive effort In practice such conditions are rarely achieved. However, at-rest pressures are still useful in design as either a baseline against which other pressure states can be judged or as an assumed conservative choice for the design loading

At-rest effective lateral pressures are often assumed to follow a linear distribution (Fig. 6 2), with the effective lateral pressure σ_x taken as a simple multiple of the vertical effective pressure σ_z'

$$\sigma_x' = K_0(\sigma_z') \tag{6 1}$$

In homogeneous, dry soil with a constant K_0 and unit weight, both the vertical and lateral pressures are linearly distributed. With the presence of a water table, the at-rest pressure distribution exhibits a break in slope at the water table, reflecting the use of submerged unit weights to determine vertical effective stresses (Fig. 6 2)

Our early concepts of the parameter K_0 were formed on the basis of normally consolidated soils Jaky (1944) proposed a relationship between K_0 and the drained friction angle ϕ' for normally consolidated soils

$$K_0 = 1 - \sin\phi' \tag{6 2}$$

Numerous studies have confirmed the general validity of this empirical equation (Brooker and Ireland, 1965, Mayne and Kulhawy, 1982) However, results from laboratory experiments and in-situ tests have shown that the K_0 value also varies as a function of overconsolidation ratio (OCR) and stress history For the case of a soil that has been subjected to one or more cycles of unloading, Schmidt (1966) proposed that K_0 can be determined as a function of its value in the normally consolidated state using the relationship

$$K_{0_u} = K_{0_{nc}}(\mathrm{OCR})^{\alpha} \tag{6 3}$$

in which K_{0_u} is the coefficient for unloading, $K_{0_{nc}}$ is the coefficient for the normally consolidated soil, and α is a dimensionless coefficient Experimental data have confirmed this relationship, and Mayne and Kulhawy (1982) showed that, for most soils, α can be taken as $\sin\phi'$

Soils that are overconsolidated and are in the process of being reloaded pose a difficulty in that Equation 6 3 does not apply For this condition, a more complex equation is needed as well as a full knowledge of the stress history of the soil (Mayne and Kulhawy, 1982) For practical purposes, it may be enough to know that the K_0 during reloading falls about halfway between that for unloading and normally consolidated conditions Also, K_0 might be directly determined through in-situ testing methods.

Table 6 1 presents typical values for K_0 for a subset of soils For other conditions, K_0 values can be determined directly from Equations 6 2 and 6 3, and/or using in-situ testing techniques.

Because the K_0 value in a given soil often varies with depth, and the soil types themselves may change with depth, the at-rest lateral pressure distribution is typically not linear as shown in Figure 6 2. Self-boring pressuremeter tests in clays with overconsolidated profiles induced by desiccation have demonstrated that the K_0 under such conditions decreases with depth in the soil deposit and reaches a steady state where the desiccation effects are no longer present (Clough and Denby, 1980)

TABLE 6 1 TYPICAL COEFFICIENTS OF LATERAL EARTH PRESSURE AT REST

	Coefficient of Lateral Earth Pressure			
Soil type	*OCR = 1*	*OCR = 2**	*OCR = 5**	*OCR = 10**
Loose sand	0 45	0 65	1 10	1 50
Medium sand	0 40	0 60	1 05	1 55
Dense sand	0 35	0 55	1 00	1 50
Silt	0 50	0 70	1 10	1 60
Lean clay CL	0 60	0 80	1 20	1 65
Highly plastic clay CH	0 65	0 80	1 10	1 40

* Unloading cycle

6 2 ACTIVE AND PASSIVE LATERAL EARTH PRESSURES

Most walls move, either by global shifting or by local deformations These movements cause adjustments to occur in the earth loads and the pressure distributions Conventional means for assessing the effects of system movements are to set them into the context of extreme conditions These are referred to as the active and passive earth pressure loadings

6 2 1 Active Pressure

Assuming that a gravity wall with no friction on its face is translated away from a soil mass that is initially at the at-rest condition then the soil mass adjacent to the wall will pass into a failure state as shown in Figure 6 3 At this stage the

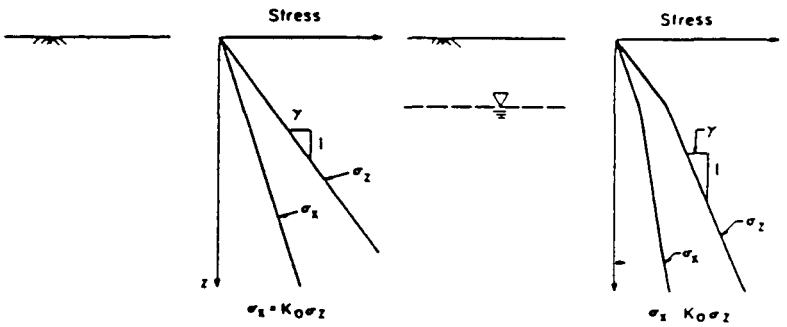


Fig 6 2 At rest earth pressure distribution—homogeneous soil

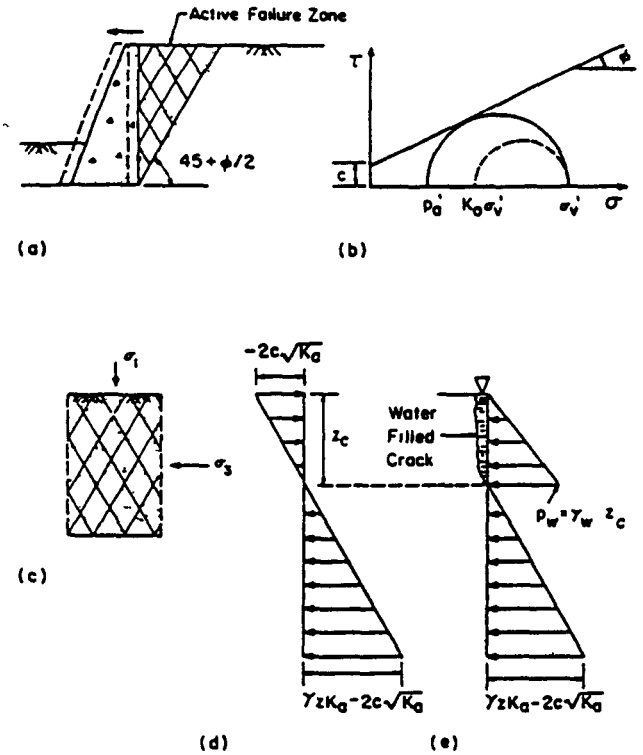


Fig 6 3 Active pressure—frictionless wall (a) Frictionless wall moves away from backfill (b) Stress state in active failure (c) Active failure zone (d) Theoretical active pressure distribution (e) Water-filled crack in tension zone

.l fails with the vertical stress unchanged from its original value, but with the lateral pressure decreased to a minimum value that can be defined using the Mohr–Coulomb failure criterion The minimum lateral pressure is known as the active pressure; and denoted by the symbol p_a It is desirable to reach this condition if possible, since it reduces the amount of load that the wall will have to carry while allowing the soil to share in the load-bearing process

For the frictionless wall with a level backfill, the active pressure can be calculated from the geometry of the Mohr diagram in Figure 6 3 by the equation

$$p_a = k_a \gamma z - 2c\sqrt{k_a} \tag{6 4}$$

where $k_a = \tan^2(45° - \phi/2)$, and is referred to as the active pressure coefficient Other terms are γ, the unit weight, ϕ, the friction angle c the cohesion, and z, the depth below the ground surface The distribution of active pressure as shown in Figure 6 3 is linear If the soil has a cohesion component the soil is in a state of tension of a depth of $2c/\gamma\sqrt{k_a}$ Ordinarily it should not be assumed that this portion of the diagram will act on a wall but rather that a tension crack will form to this depth and fill with water which then exerts a positive pressure on the wall

Equivalent Fluid Unit Weight If the backfill is composed of cohesionless soil as is often the case, then the active earth pressure equation reduces to

$$p_a = k_a \gamma z \tag{6 5}$$

is can also be written as

$$p_a = \gamma_{eq} z \tag{6 6}$$

where the term γ_{eq} is known as the equivalent fluid unit weight for active pressure loading, and equals $k_a\gamma$ This term is often used in design and it should be realized in using it that the simplifying assumptions used in the derivations of this point are also incorporated in the equivalent fluid unit weight concept

Surcharge and Nonhomogeneous Conditions Design conditions often call for incorporation of a surcharge on the ground surface adjacent to the wall. In the case of a frictionless wall, the active pressure due to soil weight and surcharge, as shown in Figure 6 4, can be calculated using the equation

$$p_a = k_a(\gamma z + q_s) \tag{6 7}$$

where q_s is the surcharge pressure.

Where a water table is situated above the bottom of the wall, or the soil involved is nonhomogeneous, Equations 6 4 and 6 7 can be used if the proper allowance is made for the submergence effect and the changing properties for the soil layers Figure 6 5 illustrates these considerations for cohesionless soil

Force Polygon Solution for Active Loadings The equations presented to this point are limited to consideration of relatively simple conditions. More complex conditions can be included using a force polygon analysis based on assumed kinematic failure mechanisms developing in the soil. One of the more important conditions that can be considered in this way is the case of friction developing between the wall and the soil as a result of relative movements between them. Figure 6 6 illustrates this situation for the case of a wall translating away from a homogeneous soil

Assuming a straight-line failure surface in the backfill as the wall moves away from the soil, the equilibrium of the soil wedge bounded by the wall and the backfill failure surface can be examined in the force polygon in Figure 6 6 The force E required to maintain equilibrium is exerted by the wall In the most general situation, the critical value of the force between the wall and the soil is found by working with trial slopes of failure wedge until the maximum value of the stabilizing force E is obtained

For relatively simple conditions where the soil backfill is level and the wall face is vertical, the inclination of the failure surface in the soil that yields the minimum earth loading is $45° + \phi/2$ to the horizontal Under these conditions, if wall friction is zero, then the kinematic force polygon procedure yields the same answer for the active load as Equation 6 4 If the wall friction is positive in the sense shown in Figure 6 6 then the active loading for most cases is slightly reduced from the case of no friction More importantly, the vertical shear

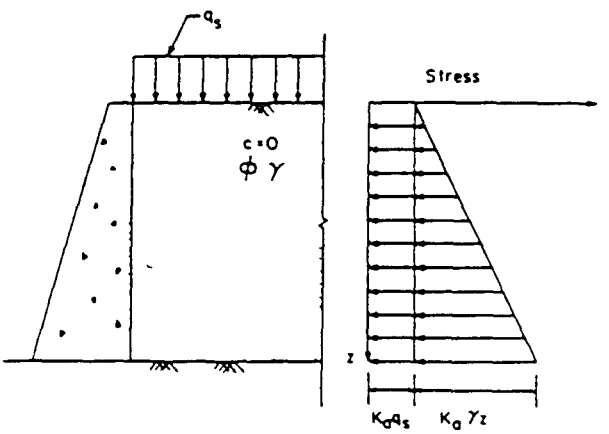


Fig 6 4 Frictionless wall with surcharge

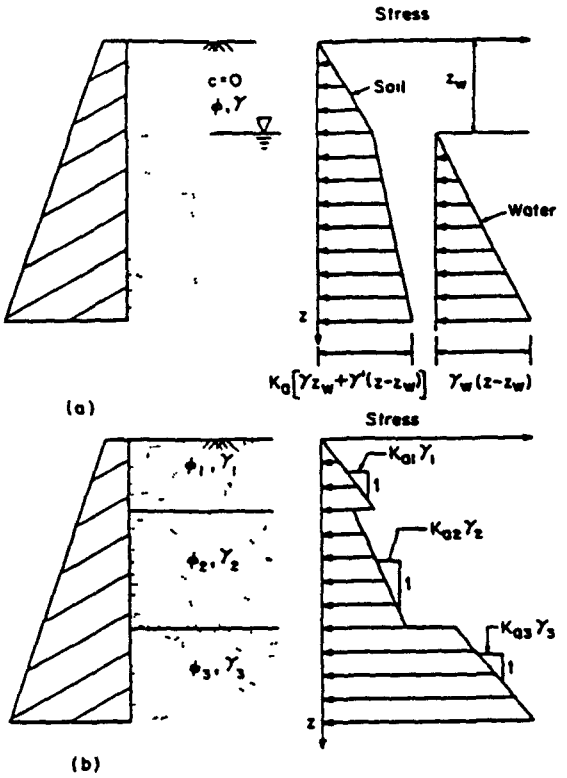


Fig 6 5 Active pressures for frictionless wall in presence of groundwater table and nonhomogeneous soil conditions. (a) Groundwater table (b) Nonhomogeneous cohesionless soil

orce that is generated helps to combat overturning and increases the resistance against sliding of the wall

A general formula can be developed for active earth load acting on a wall for the case of a homogeneous soil backfill with arbitrary degrees of wall friction, wall slope, and backfill surface slope Assuming that the failure surface in the backfill is a straight line, the formula is as shown in Figure 6 7 In the event of relatively complex backfill or wall geometries or surcharge conditions, then the exact failure surface that yields the minimum earth load can be found by a trial procedure. A number of references describe this process, and examples can be found in the original edition to this handbook.

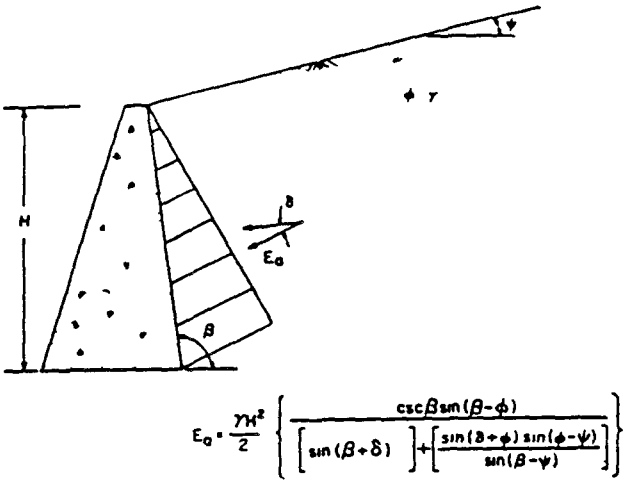


Fig 6 7 Closed-form solution for active earth loading, rough wall sloping wall face and backfill

Further Comments on Active Load Determinations The kinematic analysis in Figure 6 6 assumes that the failure surface is a straight line In fact, in the most general case of a soil whose failure is governed by a Mohr–Coulomb criterion, and which has a friction component, the correct failure surface under active conditions consists of a log spiral, as shown in Figure 6 8 However, in the active state, the log-spiral shape is reasonably approximated by a straight line, and the resultant load predicted using the simple straight-line failure mechanism is within 10 percent of that obtained with the more exact log-spiral mechanism

Table 6 2 presents values for the active pressure coefficient that allow calculation of the active loading resultant as shown for conditions where wall friction, sloping backfill and a sloping wall face exist These coefficients are based on the log-spiral failure surface assumption A graphical format for the active pressure coefficient from the log-spiral analysis that is useful for many practical problems is given in Figure 6 9 It assumes a vertical wall face and horizontal backfill For conditions encountered that deviate from those described in Table 6 2 or in Figure 6 9, the trial procedure can be used assuming straight-line failure surfaces in the soil

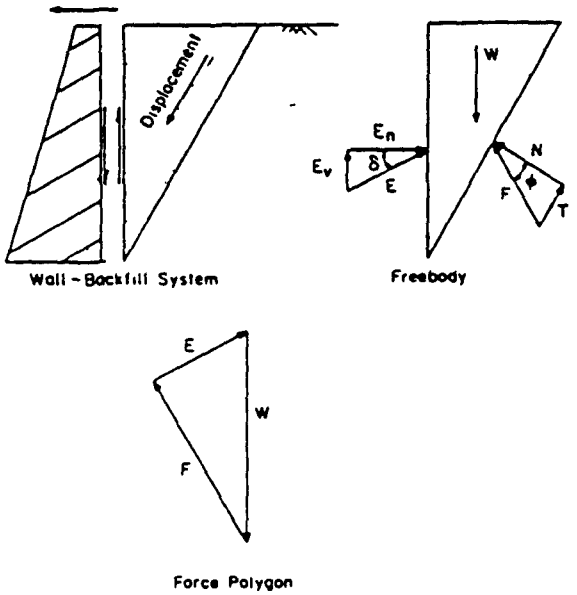


Fig 6 6 Force polygon solution for active loading

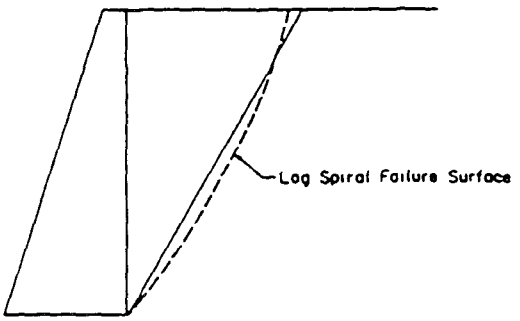


Fig 6 8 Comparison of log-spiral and straight line failure surfaces for active conditions

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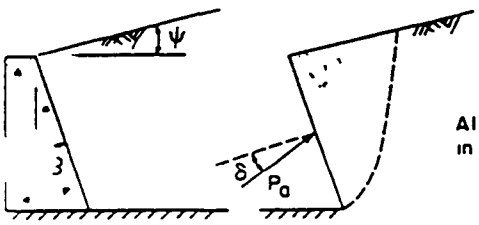
TABLE 6 2 VALUES OF k_a FOR LOG SPIRAL FAILURE SURFACE.

υ deg	ψ deg	β deg	ϕ deg 20	25	30	35	40	45
		−10	0 37	0 30	0 24	0 19	0 14	0 11
	−15	0	0 42	0 35	0 29	0.24	0 19	0 16
		10	0 45	0 39	0.34	0.29	0.24	0.21
		−10	0 42	0 34	0 27	0 21	0 16	0 12
0	0	0	0 49	0 41	0 33	0 27	0 22	0 17
		10	0 55	0 47	0 40	0.34	0.28	0 24
		−10	0 55	0 41	0 32	0 23	0 17	0 13
	15	0	0 65	0 51	0 41	0 32	0 25	0.20
		10	0 75	0 60	0 49	0 41	0 34	0.28
		−10	0 31	0 26	0.21	0 17	0 14	0 11
	−15	0	0 37	0.31	0.26	0 23	0 19	0 17
		10	0 41	0 36	0.31	0 27	0 25	0.23
		−10	0 37	0 30	0.24	0 19	0 15	0 12
ϕ°	0	0	0 44	0.37	0 30	0.26	0 22	0 19
		10	0 50	0 43	0 38	0.33	0 30	0 26
		−10	0 50	0.37	0.29	0.22	0 17	0 14
	15	0	0 61	0 48	0 37	0.32	0 25	0.21
		10	0 72	0 58	0 46	0 42	0 35	0 31

*After Caquot and Kerisel (1948)



All angles shown in positive sense

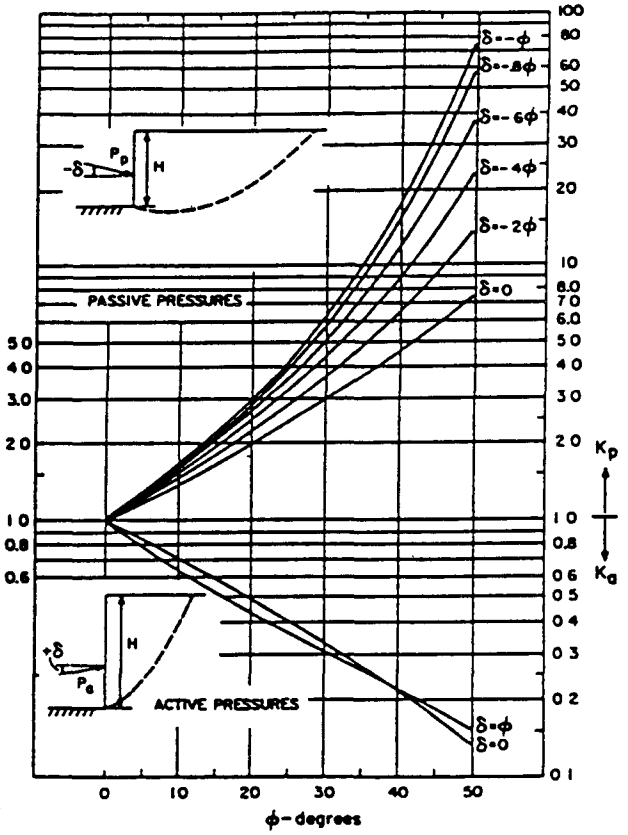


Fig 6 9 Active and passive pressure coefficients for vertical wall and horizontal backfill based on log-spiral failure surfaces (*After Caquot and Kerisel 1948*)

6 2 2 Passive Pressures

Passive pressure conditions develop where a structure is forced into a soil mass This situation is most commonly associated with the soil located on the opposite side of the wall from the backfill (Fig. 6 10) Assuming that a frictionless wall is forced into a soil mass that is originally at-rest, the end result will be that a portion of the soil mass will pass into a passive failure condition as shown in Figure 6 11 The soil fails with the vertical stress unchanged from its original value, but with the horizontal stress increased to a maximum value as defined by the Mohr–Coulomb failure criterion The maximum pressure is denoted by the symbol p_p, and it is defined from the geometry of the Mohr diagram in Figure 6 10 by the equation

$$p_p = \gamma z k_p + 2c\sqrt{k_p} \qquad (6\,8)$$

where k_p is the passive pressure coefficient, and can be expressed as follows

$$k_p = \tan^2\left(45° + \frac{\phi}{2}\right) \qquad (6\,9)$$

In Figure 6 10 the passive pressure distribution defined by Equation 6 8 is shown to be linear and in compression throughout.

Uniform surcharge for cohesionless soils can be incorporated in Equation 6 8 in the form

$$p_p = k_p(\gamma z + q_s) \qquad (6\,10)$$

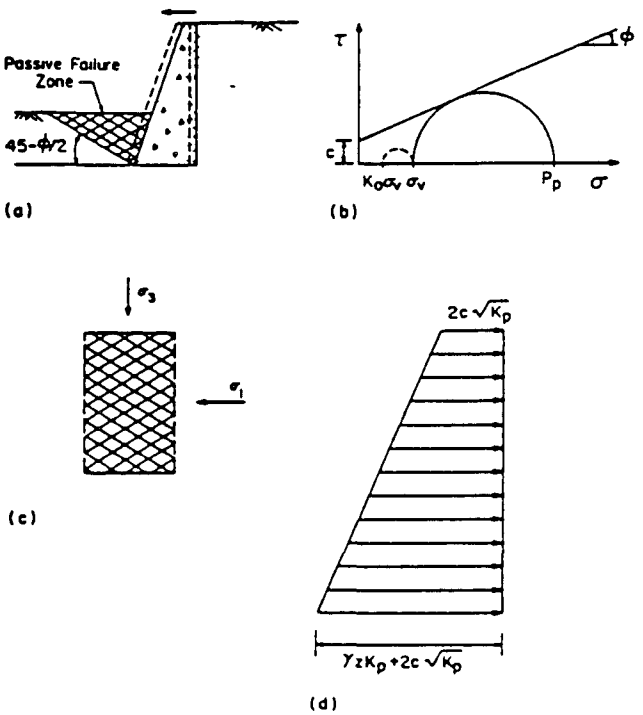


Fig 6 10 Passive pressure—active wall (a) Frictionless wall moves into soil (b) Stress state in passive failure (c) Passive failure zone (d) Theoretical pressure distribution

6. Structural Design Calculations for Concrete Vault (Settling Basin)

AMCOR Precast
COLORADO DIVISION

DESIGN CRITERIA FOR UNDERGROUND PRECAST CONCRETE STRUCTURES

MATERIALS:

-General Description	
-Concrete 28 day compressive strength.. .. .	4,500psi
-Cement, unless otherwise specified by the project shall be ..	TYPE II or III
-Reinforcing Steel is Grade 60 with yield strength	60,000psi
-Admixtures, as described in the batch design, will include..	air-entraining agent water-reducing agent accelerator

BATCH DESIGN: (1 cubic yard)

-Cement		600 lbs.
-Sand		1,400 lbs
-3/4" Aggregate		1,700 lbs
-Water		28 Gals.
-DV-1000	(W R Grace/Air-Entrainment Agent)	6 ozs
-WRDA-64	(W R Grace/Water-Reducing Agent)	30 ozs.
-POLARSET	(W R Grace/Accelerator)	60 ozs

SPECIFICATIONS:

Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. ...	ASTM A615
Specifications for Concrete Aggregates	ASTM C33
Test Method for Compressive Strength of Cylindrical Concrete Specimens	ASTM C39
Method to Sieve Analysis for Fine and Coarse Aggregates	ASTM C136
Test Method for sump of Portland Cement Concrete	ASTM C143
Specification for Portland Cement	ASTM C150
Method of Making and Curing Concrete Test Specimens in the Laboratory	ASTM C192
Test Method of Air Content of Freshly Mixed Concrete by the Pressure Method	ASTM C231
Specification for Air-Entrainment Admixtures for Concrete	ASTM C260
Specification for Chemical Admixtures for Concrete	ASTM C494
Recommended Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures	ASTM C857
Specification for Underground Precast Concrete Utility Structures	ASTM C858
Specification for Design of Concrete using Ultimate Strength Methods	ACI 318-89

LOADING.

Maximum Soil Density	120 PCF
Equivalent Fluid Pressure (Active Soil Pressure)	52 PCF
HS 20 Live Load of Axle	32 KIPS
HS 20 Live Load of Wheel	16 KIPS
Lateral Surcharge Load	125 PSF
Soil Cover	0'-0" min 3'-0" max
Live Load increases Due to Impact.	
0" to 1'-0" of Overburden	30 %
1'-1" to 2'-0"	20 %
2'-1" to 2'-11"	10 %
3'-0" or more of Overburden	None

NOTE Upon request, Amcor Precast will furnish copies of any raw-material certifications that are required to prove compliance with the above referenced specifications.

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AMCOR Precast, Colorado Div.

6392 Riverview Pkwy.
Littleton, CO 80125

PHONE. 303-791-1100
FAX 303-791-1120

ANALYSIS AND DESIGN OF UNDERGROUND PRECAST CONCRETE STRUCTURES USING ULTIMATE STRENGTH DESIGN METHODS

VAULT:	Rocky Flats OU-7
SIZE:	5' X 12'-6" X 7'

PRODUCTS INCLUDED:	ID#	COMMENTS
LID		
BOTTOM SECTION		

APPLICABLE CODES:

[1]-AASHTO STANDARD SPECIFICATIONS for HIGHWAY BRIDGES 14TH EDITION

[2]-BUILDING CODE REQUIREMENTS for REINFORCED CONCRETE ACI 318-89 & ACI 318R-89

[3]-ASTM STANDARD PRACTICE for MINIMUM STRUCTURAL DESIGN LOADING for UNDERGROUND PRECAST CONCRETE WATER AND WASTEWATER STRUCTURES C890-78(Reapproved 1985)

[4]-PCA DESIGN CRITERIA FOR AIRCRAFT LOADING (for wheel loading only) SHEET MS 026 02P

NOTE: Code selection is predicated on most stringent design criteria and/or practical engineering science

18-Sep-95
08 24 02 AM

1.99' Soil Cover
Governs for:
Lid and Floor

125

ANALYSIS & DESIGN OF UNDERGROUND–PRECAST STRUCTURES *VERSION 2.4*

BASIC DESIGN PARAMETERS AND INPUT DATA
CODE REFERENCES ARE MADE WHEN APPLICABLE/OTHERWISE BASIC ENGINEERING APPLIES

Input	INPUT TYPE OF STRUCTURE "U" for Utility, "W" for Water Related			W
Input	VAULT:	ROCKY FLATS OU-7	SIZE:	8' X 12'-6" X 7'

NOTE: PLACEMENT OF REBAR: INCHES OF COVER FROM TENSION SURFACE

	MACROS Shear&Moment	COMPONENT CHECKLIST:	PRODUCT ID	MARK WITH "X"	THICKNESS OR INSIDE HEIGHT		INCHES	
Input	A & B	LID		X	8 00	IN	1 50	Y
Input	C & D	TOP SECTION			0 00	FT	0 00	N
Input	E & F	RISER			0 00	FT	0 00	N
Input	G & H	BOTTOM SECTION		X	7 00	FT	0 00	Y
Input	I & J	BASE OF A BOTTOM SECTION			8 00	IN	1 50	Y
Input		WALL THICKNESS			8 00	IN		
Input		INSIDE VAULT WIDTH(SHORT)			8 00	FT		
Input		INSIDE VAULT WIDTH(LONG)			12 50	FT		
Input	R	REBAR SCHEDULE (PRINTOUT OPTION)						N

	DATA COMMON TO ALL COMPONENTS:	VALUE	UNITS	NOTES	
	fy	60,000	PSI	GRADE 60	
Input	f'c	4,500	PSI	@ 28 DAYS	
Input	DEPTH OF FILL	1 99	FEET	ON LID	USE 2' FOR HS20 LOAD
Input	SURCHARGE HEIGHT(USE 2' WITH WHEEL LOADING)	2 40	FEET	ABOVE FILL	AASHTO 3.20 3
Input	SOIL DENSITY(120 MINIMUM)	120	PCF	DRY WT	> or = AASHTO 6 2.1
Input	EQUIVALENT SOIL FLUID PRESSURE(30 MINIMUM)	52	PCF	ON WALLS	> or = AASHTO 6 2 1
Input	WHEEL LOADING: "YES" or "NO"	WHEEL LOAD	YES	SPACING	AIR=2.833' ,H20=6'
Input	HS20 LOAD *CONCENTRATED WHEEL LOAD*	16	KIPS@FT=	6 00	AASHTO 3.7

LOAD FACTORS.GROUP X LOADING:gamma=1.3			LF	NOTES	
LIVE LOAD FACTOR	L=1 67	(ACI = 1 7)	1 70	gamma x L	AASHTO 3.22
DEAD LOAD FACTOR	BetaD=1 0	(ACI = 1 4)	1 40	gamma x BetaD	AASHTO 3 22, =2 17
SOIL LOAD FACTOR	BetaE=1 0	(ACI = 1 7)	1 70	gamma x BetaE	AASHTO 3 22, =1 3

PLAN VIEW DIMENSIONS:	VALUE	UNITS	
OUTSIDE LID/BASE WIDTH	7 00	FEET	
OUTSIDE LID/BASE LENGTH	13 50	FEET	
INSIDE VAULT WIDTH	6 00	FEET	
INSIDE VAULT LENGTH	12 50	FEET	

SUMMARY OF WEIGHTS AND SOIL LOADING(UNFACTORED) ON COMPONENTS

WEIGHT LBS	COMPONENT	"X" FT	VERTICAL PSF	HORIZ. LOAD PSF	POSITION OF "X" FROM TOP OF SOIL
9450 00	LID	1 99	288 80		TOP OF LID
	LID	5 06		262 95	BOTTOM OF LID
0 00	TOP SECTION	5 06		262 95	BOTTOM OF WALL
0 00	RISER	5 06		262 95	BOTTOM OF WALL
27562 50	BOTTOM SECTION	5 06		262 95	TOP OF WALL
0 00	BASE OF A BOTTOM SECTION	12 06	630 47	626 95	TOP OF BASE
37012 50	TOTAL WEIGHT OF CONCRETE	BUOYANCY CHECK			N
1508 55	TOTAL WEIGHT OF REBARS				
81 52	LBS REBAR/TONS CONCRETE				

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no input SIZE 6' X 12'-6" X 7' 18-Sep

A

SHEAR ANALYSIS OF LID:

BASIC DATA

CONCRETE COVER TO REBAR: 1 50 INCH

INSIDE VAULT WIDTH	6 00 FT	
INSIDE VAULT LENGTH	12.50 FT	
WALL THICKNESS	8 INCHES	
RATIO, LENGTH WIDTH	2.08	
ONE-WAY SLAB DESIGN:		AASHTO 3.24.6 1
% OF LOAD IN SHORT DIRECTION	100 00%	AASHTO 3 24 6 1
% OF LOAD IN LONG DIRECTION	0 00%	AASHTO 3.24.6.1
SLAB THICKNESS	8 INCHES	
SHORT SPAN LENGTH	6 50 FEET	
LONG SPAN LENGTH	13 00 FEET	

DEAD LOADS:ultimate

SLAB	0 140 KSF
OVERBURDEN	0.334 KSF
Wudl=	0 474 KSF

LIVE LOAD,ultimate

WHEEL LOADS(P)	16 KIPS	1 WHEEL
IMPACT	30%	AASHTO 3 8.2 3
WHEEL FOOTPRINT ON LID.		ASTM C857-87
WIDTH(PARALLEL TO LONG)	0.83 FT	0 833+1 75*DEPTH OF FILL
LENGTH(PARALLEL TO SHORT)	1 67 FT	1 67+1 75*DEPTH OF FILL+
Wull	25 46 KIPS/FT	CC DIMEN of WHEELS(FT)
Pu	35 38 KIPS	

SHEAR ANALYSIS: SHORT DIRECTION

		NOTES:	
a	0 77 FT	50% OF WALL + d	ACI 11.1.3.1
b	1.67 FT	LOAD LENGTH	
c	4 07 FT	LOAD TO OTHER END	
TOTAL	6 50 FT	SPAN LENGTH	

Vu(ll)@"d"=%*(Wull)(b)((2c)+b)/2	6.07 KIPS/FT	E=	4 39	AASHTO 3.24.3.2
Vu(dl)@"d"=Wudl(l/2-a)	1 18 KIPS/FT			
Vu@"d"=	7.25 KIPS	ACTUAL Vu PER FT		
b=	12 INCHES	WIDTH	OK	
d=	6 19 INCHES			
0 85Vc=0.85*2*SQRT(f'c)*b*d	8.47 KIPS	ALLOW Vc PER FT		ACI 11 3 1.1

PAGE 2

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input SIZE: 6' X 12'-6" X 7" 18-Sep

B req'd **MOMENT/As IN LID:**

BASIC DATA

INSIDE VAULT WIDTH	6 00 FT	
INSIDE VAULT LENGTH	12.50 FT	
WALL THICKNESS	6 INCHES	
RATIO LENGTH WIDTH	2.08	
ONE-WAY SLAB DESIGN:		
% OF LOAD IN SHORT DIRECTION	100.00%	AASHTO 3 24.6 1
% OF LOAD IN LONG DIRECTION	0.00%	AASHTO 3 24 6 1
SLAB THICKNESS	8 INCHES	AASHTO 3.24.6.1
SHORT SPAN LENGTH	6.50 FEET	
LONG SPAN LENGTH	13 00 FEET	

CONCRETE COVER TO REBAR 1 50 INCH

DEAD LOADS:

SLAB	0 140 KSF	
OVERBURDEN	0.334 KSF	
Wudl=	0.474 KSF	

LIVE LOAD:

WHEEL LOADS(P)	16 KIPS	1 WHEEL
IMPACT	30%	AASHTO 3.8 2.3
WHEEL FOOTPRINT ON LID:		ASTM C857-87
WIDTH(PARALLEL TO LONG)	0 83 FT	0 833+1 75*DEPTH OF FILL
LENGTH(PARALLEL TO SHORT)	1 67 FT	1 67+1 75*DEPTH OF FILL+6FT
Wull	25.46 KIPS/FT	
Pu	35 36 KIPS	

Mid-span moment multiplication factor due degree of fixity: 100 00%

ANALYSIS OF 1' WIDE STRIP ACI 318-89 CHAPTER 10	SHORT SPAN	LONG SPAN	
a	2 42	6 08	END TO LOAD
b	1 67	0 83	LOAD LENGTH
c	2.42	6 08	LOAD TO OTHER END
SPAN LENGTH	6 50	13 00	FEET
%OF LOAD	100 00%	0 00%	
Rl(100% OF LOAD)	21 22	10 61	KIPS
Mull@l/2=(REDUCED by "% of LOAD")	11.41	0 00	E short= 4 39 E long= 4 78
Mudl@l/2=(REDUCED by "% of LOAD")	2.51	0 00	FT-KIPS AT MIDSPAN/FT WIDTH
Mu@l/2	13.92	0.00	FT-KIPS AT MIDSPAN/FT WIDTH
Mwsd@l/2	8.50	0.00	FT-KIPS AT MIDSPAN/FT WIDTH
b=	12	12	INCHES WIDTH OF STRESS BLOCK
d=	6 19	5 56	INCHES
As req'd (Neg indicates As min)	0.528	0 125	SQ INCHES(min or 133% of req'd or req'd)
As provided	0.589	0.262	SQ INCHES
input REBAR SIZE #	6	4	#
input REBAR SPACING	9	9	INCHES

CRACK CONTROL:LONG WALL/INSIDE AASHTO 8.16.8.4

ZMAX	170 KIPS/INCH	
fs	31 08 KSI	
dc	1.88 INCHES	OK
A=(2*dc*bar spacing) PER BAR	33 75 SQ INCHES	
Z Actual=fs*(dc*A)^0.3333	124 KIPS/INCH	

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no input SIZE 6' X 12'-6" X 7'

G

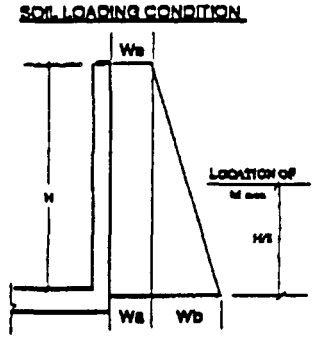
SHEAR ANALYSIS OF BOTTOM SECTION

BASIC DATA

CONCRETE COVER TO REBAR. 2.69 INCH

INSIDE VAULT WIDTH	6.00 FT	
INSIDE VAULT LENGTH	12.50 FT	
WALL THICKNESS	6.00	
INSIDE HEIGHT	7 00	
TWO WAY WALL DESIGN:		ASSHTO 3 24 6 1
% OF LOAD IN CANTILEVER DIRECTIO	31 73%	
% OF LOAD IN LONG WALL/BENDING	68.27%	
SLAB THICKNESS	6 00 INCHES	
SHORT SPAN LENGTH	6.50 FEET	
LONG SPAN LENGTH	13.00 FEET	
DEPTH TO TOP OF WALL	5.06 FEET	
DEPTH TO BOTTOM OF WALL	12.06 FEET	

SOIL LOADING CONDITION



LATERAL SOIL PRESSURES-ultimate

Wa=	0.447 KSF
Wb@"d"=	0 592 KSF
Wb	0.619 KSF

SHEAR VALUES.@TOP OF BASE

x=SPAN-"d"	6 70 FT	
Vu@"d"=	1 55 KIPS	ACTUAL Vu PER FT
b=	12.00 INCHES	OK
d=	3.63 INCHES	
0.85Vc=0.85*2*SQRT(f'c)*b*d	4.96 KIPS	ALLOW.VcPER FT

SHEAR VALUES:@END OF LONG WALL

x=SPAN-"d"	12 00 FT		
Vu@"d"=	1 83 KIPS	ACTUAL Vu PER FT	ACI 11.1.3.1
b=	12.00 INCHES	OK	
d=	3 00 INCHES		
0 85Vc=0.85*2*SQRT(f'c)*b*d	4.11 KIPS	ALLOW.VcPER FT	ACI 11 3 1 1

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Input SIZE· 6' X 12'-6" X 7'

H req'd **MOMENT/As IN WALL OF BOTTOM SECTION**

input required on this sheet		
INSIDE VAULT WIDTH	6.00	FT
INSIDE VAULT LENGTH	12.50	FT
WALL THICKNESS	6.00	
INSIDE HEIGHT	7.00	
TWO WAY WALL DESIGN:		
% OF LOAD IN CANTILEVER DIRECTIO	31.73%	
% OF LOAD IN LONG WALL/BENDING	68.27%	
SLAB THICKNESS	6.00	INCHES
SHORT SPAN LENGTH	6.50	FEET
LONG SPAN LENGTH	13.00	FEET
DEPTH TO TOP OF WALL	5.06	FEET
DEPTH TO BOTTOM OF WALL	12.06	FEET

CONCRETE COVER TO REBAR: 2.06 INCH

STIFFNESS METHOD..AASHTO 8.6
STIFFNESS METHOD AASHTO 8 6
STIFFNESS METHOD..AASHTO 8.6

LATERAL SOIL PRESSURES ultimate

Wa=	0.447 KSF
Wb=(@H/2)	0.309 KSF

ANALYSIS OF 1' WIDE STRIP ACI 318-89 CHAPTER 10	CANT SPAN	BENDING LONG L	BENDING CORNER	+or-M BENDING SHORT L		
SPAN LENGTH	7.00	13.00		6.50	FEET	
%OF LOAD	31.73%	68.27%	68.27%	68.27%		
Mudl due to Wa	3.47	3.22	3.22	-1.61	FT-KIPS	PER FT OF WIDTH
Mudl due to Wb	1.60	2.23	2.23	-1.12	FT-KIPS	PER FT OF WIDTH
Mu=	5.08	5.45	5.45	-2.73	FT-KIPS	PER FT OF WIDTH
Mused=	2.99	3.21	3.21	-1.60	FT-KIPS	PER FT OF WIDTH
b=	12	12	12	12	INCHES	WIDTH
d=	3.63	3.00	3.00	3.00	INCHES	
As req'd (Neg indicates As min)	0.331	0.448	0.448	0.194	(min or 1.33% of req'd or req'd)	
check As provided	0.409	0.480	0.480	0.480	SQ INCHES	
input REBAR SIZE #	5	5	5	5	#	
input REBAR SPACING	9	8	8	8	INCHES	
	**	++	**	++		

** MUST HAVE REBAR INPUT WHEN CANTILEVER=100% see cell m196
++MUST HAVE REBAR SIZE=0 WHEN CANTILEVER=100% see cell m195

CRACK CONTROL-LONG WALL/INSIDE AASHTO 8 16 8 4

Z MAX	170
fs=	25 99 KSI
dc=	2.38 INCHES
A=(2*dc*bar spacing) PER BAR	38 00 SQ-INCH
Z Actual=fs*(dc*A) ^0 3333	117

OK

PAGE 5

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no input SIZE 6' X 12'-6" X 7'

SHEAR ANALYSIS OF BASE SLAB OF BOTTOM SECTION

BASIC DATA

INSIDE VAULT WIDTH	6.00 FT	
INSIDE VAULT LENGTH	12.50 FT	
WALL THICKNESS	6.00 INCHES	
RATIO LENGTH/WIDTH	2.08	
ONE-WAY SLAB DESIGN:		AASHTO 3.24.6.1
% OF LOAD IN SHORT DIRECTION	100.00%	AASHTO 3.24.6.1
% OF LOAD IN LONG DIRECTION	0.00%	AASHTO 3.24.6.1
SLAB THICKNESS	6 INCHES	
SHORT SPAN LENGTH	6.50 FEET	
LONG SPAN LENGTH	13.00 FEET	

CONCRETE COVER TO REBAR: 1.50 INCH

DEAD LOADS-ultimate

VAULT	0.548 KSF
OVERBURDEN	0.334 KSF
Wudl=	0.883 KSF

LIVE LOAD:ultimate (Wull only) NOTES: ASTM C857-67

WHEEL LOAD(P) (above lid)	32.00 KIPS	2 WHEELS
TRANSFERRED TO BASE(ultimate)	54.40 KIPS	0.88 W OF FOOTPRINT ON LID
IMPACT	0.00%	0.83 WMAX -
DISTRIBUTION AREA	94.50 FT2	1.67 L OF FOOTPRINT ON LID
Wull=	0.58 KSF	1.67 LMAX

SHEAR ANALYSIS SHORT DIRECTION

a=50% OF WALL + d	0.60 FT	50% OF WALL + d	ACI 11.1.3.1
Vu(dl)@"d"=%*Wudl*(l/2-a)	2.34 KIPS	SHORT SPAN	
Vu(ll)@"d"=%*(Wull)*(l/2-a)	1.53 KIPS	SHORT SPAN	
Vu@"d"=	3.87 KIPS	ACTUAL Vu PER FT	
b=	12 INCHES	WIDTH	OK
d=	4.19 INCHES		
0.85Vc=0.85*2*SQRT(f'c)*b*d	5.72 KIPS	ALLOW Vu PER FT	ACI 11.3.1.1

PAGE 6

input SIZE: 6' X 12'-6" X 7"

J req'd **MOMENT/As IN BASE SLAB OF BOTTOM SECTION**

BASIC DATA

CONCRETE COVER TO REBAR: 1.50

INSIDE VAULT WIDTH	6.00 FT		
INSIDE VAULT LENGTH	12.50 FT		
WALL THICKNESS	6		
RATIO: LENGTH:WIDTH	2.08		
ONE-WAY SLAB DESIGN:		USED FOR	AASHTO 3.24.6.1
% OF LOAD IN SHORT DIRECTION	100.00%	MOMENT	AASHTO 3.24.6.1
% OF LOAD IN LONG DIRECTION	0.00%	MOMENT	AASHTO 3.24.6.1
SLAB THICKNESS	6	INCHES	
SHORT SPAN LENGTH	6.50	FEET	
LONG SPAN LENGTH	13.00	FEET	

DEAD LOADS.ultimate

VAULT	0.548	KSF	37,013 LBS
OVERBURDEN	0.334	KSF	
Wudl=	0.883	KSF	

LIVE LOAD:ultimate (Wull only)

WHEEL LOAD(P)	32	KIPS	2 WHEELS
IMPACT	0%		AASHTO 3.8.2.3
DISTRIBUTION AREA	94.50	FT2	ASTM C857-87
Wull=	0.68	KSF	

Mid-span moment multiplication factor due degrees of fixity: 100.00%

ANALYSIS OF 1' WIDE STRIP ACI 318-89 CHAPTER 10	SHORT SPAN	LONG SPAN		
SPAN LENGTH	6.50	13.00	FEET	
%OF LOAD	100.00%	0.00%		
				REACTION AT END/FT WIDTH
Mudl@l/2=	4.68	0.00	FT-KIPS	PER FT WIDTH
Mull@ l/2	3.04	0.00	FT-KIPS	PER FT WIDTH
Mu@l/2	7.70	0.00	FT-KIPS	PER FT WIDTH
Mwsd@l/2	5.12	0.00	FT-KIPS	PER FT WIDTH
b=	12	12	INCHES	WIDTH
d=	4.19	3.56	INCHES	
As req'd (Neg indicates As min)	0.439	0.125	SQ INCHES	(min. or 1.33% of req'd or req'd)
check As provided	0.480	0.282	SQ INCHES	
input REBAR SIZE #	5	4	#	
input REBAR SPACING	8	9	INCHES	

CRACK CONTROL:LONG WALL/INSIDE AASHTO 8.16.8.4

Z MAX 170	170	KIPS/INCH
fs	35.63	KSI
check dc	1.81	INCHES
A=(2*dc*bar spacing) PER BAR	29.00	SQ INCHES
Z Actual=fs*(dc*A)^0.3333	133	KIPS/INCH

OK

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AMCOR Precast—Colorado Div.

8392 Riverview Pkwy.
Littleton, CO. 80125

PHONE 303-791-1100
FAX 303-791-1120

ANALYSIS AND DESIGN OF UNDERGROUND PRECAST CONCRETE STRUCTURES USING ULTIMATE STRENGTH DESIGN METHODS

VAULT:	Rocky Flats OU-7
SIZE:	6' X 12'-6" X 7'

PRODUCTS INCLUDED:	ID#	COMMENTS
LID		
BOTTOM SECTION		

APPLICABLE CODES:

[1]—AASHTO STANDARD SPECIFICATIONS for HIGHWAY BRIDGES 14TH EDITION

[2]—BUILDING CODE REQUIREMENTS for REINFORCED CONCRETE ACI 318—89 & ACI 318R—89

[3]—ASTM STANDARD PRACTICE for MINIMUM STRUCTURAL DESIGN LOADING for UNDERGROUND PRECAST CONCRETE WATER AND WASTEWATER STRUCTURES: C890—78(Reapproved 1985)

[4]—PCA DESIGN CRITERIA FOR AIRCRAFT LOADING (for wheel loading only) SHEET MS 026 02P

NOTE Code selection is predicated on most stringent design criteria and/or practical engineering science

18-Sep-95
07 39 48 AM

3'-0" Soil Cover
Governs for:
Walls

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ANALYSIS & DESIGN OF UNDERGROUND–PRECAST STRUCTURES *VERSION 2.4*

BASIC DESIGN PARAMETERS AND INPUT DATA
CODE REFERENCES ARE MADE WHEN APPLICABLE/OTHERWISE BASIC ENGINEERING APPLIES

input	INPUT TYPE OF STRUCTURE "U" for Utility, "W" for Water Related			W
input	VAULT:	ROCKY FLATS CKT-7	SIZE:	6' X 12'-6" X 7'

NOTE: . . . PLACEMENT OF REBAR:INCHES OF COVER FROM TENSION SURFACE

	MACROS Shear&Moment	COMPONENT CHECKLIST:	PRODUCT ID	MARK WITH "X"	THICKNESS OR INSIDE HEIGHT		INCHES	
input	A & B	LID		X	8.00	IN	1 50	Y
input	C & D	TOP SECTION			0 00	FT	0 00	N
input	E & F	RISER			0 00	FT	0 00	N
input	G & H	BOTTOM SECTION		X	7 00	FT	0 00	Y
input	I & J	BASE OF A BOTTOM SECTION			6.00	IN	1 50	Y
input		WALL THICKNESS			6.00	IN		
input		INSIDE VAULT WIDTH(SHORT)			6.00	FT		
input		INSIDE VAULT WIDTH(LONG)			12.50	FT		
input	R	REBAR SCHEDULE (PRINTOUT OPTION)						N

	DATA COMMON TO ALL COMPONENTS	VALUE	UNITS	NOTES	
	fy	60,000	PSI	GRADE 60	
input	f'c	4 500	PSI	@ 28 DAYS	
input	DEPTH OF FILL	3.00	FEET	ON LID	USE 2' FOR HS20 LOAD.
input	SURCHARGE HEIGHT(USE 2' WITH WHEEL LOADING)	2.40	FEET	ABOVE FILL	AASHTO 3.20 3
input	SOIL DENSITY(120 MINIMUM)	120	PCF	DRY WT	> or = AASHTO 6.2.1
input	EQUIVALENT SOIL FLUID PRESSURE(30 MINIMUM)	52	PCF	ON WALLS	> or = AASHTO 6.2.1
input	WHEEL LOADING "YES" or "NO"	WHEEL LOAD	YES	SPACING	AIR=2 833' ,H20=6'
input	HS20 LOAD *DISTRIBUTED THRU SOIL*	16	KIPS@FT=	6 00	AASHTO 3.7

LOAD FACTORS GROUP X LOADING·gamma=1 3			LF	NOTES	
LIVE LOAD FACTOR	L=1.67	(ACI = 1 7)	1 70	gamma x L	AASHTO 3 22
DEAD LOAD FACTOR·	BetaD=1.0	(ACI = 1 4)	1.40	gamma x BetaD	AASHTO 3.22, =2.17
SOIL LOAD FACTOR	BetaE=1 0	(ACI = 1 7)	1 70	gamma x BetaE	AASHTO 3.22, =1.3

PLAN VIEW DIMENSIONS·	VALUE	UNITS
OUTSIDE LID/BASE WIDTH	7 00	FEET
OUTSIDE LID/BASE LENGTH	13 50	FEET
INSIDE VAULT WIDTH	6 00	FEET
INSIDE VAULT LENGTH	12 50	FEET

SUMMARY OF WEIGHTS AND SOIL LOADING(UNFACTORED) ON COMPONENTS·

WEIGHT LBS	COMPONENT	"X" FT	VERTICAL PSF	HORIZ LOAD PSF	POSITION OF "X" FROM TOP OF SOIL
9450 00	LID	3 00	360 00		TOP OF LID
	LID	6 07		315 47	BOTTOM OF LID
0 00	TOP SECTION	6 07		315 47	BOTTOM OF WALL
0 00	RISER	6 07		315 47	BOTTOM OF WALL
27562 50	BOTTOM SECTION	6 07		315 47	TOP OF WALL
0 00	BASE OF A BOTTOM SECTION	13 07	751 67	679 47	TOP OF BASE
37012 50	TOTAL WEIGHT OF CONCRETE	BUOYANCY CHECK			N
1729 10	TOTAL WEIGHT OF REBARS				
93 43	LBS REBAR/TONS CONCRETE				

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no input SIZE. 6' X 12'-6" X 7' 18-Sep

A

SHEAR ANALYSIS OF LID:

BASIC DATA

INSIDE VAULT WIDTH	6.00 FT	
INSIDE VAULT LENGTH	12.50 FT	
WALL THICKNESS	6 INCHES	
RATIO LENGTH:WIDTH	2.08	
ONE-WAY SLAB DESIGN:		AASHTO 3 24.6 1
% OF LOAD IN SHORT DIRECTION	100.00%	AASHTO 3.24.6 1
% OF LOAD IN LONG DIRECTION	0 00%	AASHTO 3 24 6.1
SLAB THICKNESS	8 INCHES	
SHORT SPAN LENGTH	6.50 FEET	
LONG SPAN LENGTH	13 00 FEET	

CONCRETE COVER TO REBAR: 1 50 INCH

DEAD LOADS-ultimate

SLAB	0 140 KSF
OVERBURDEN	0 504 KSF
Wudl=	0 644 KSF

LIVE LOAD-ultimate

WHEEL LOADS(P)	32 KIPS	2 WHEELS
IMPACT	20%	AASHTO 3 8 2.3
WHEEL FOOTPRINT ON LID.		ASTM C857-87
WIDTH(PARALLEL TO LONG)	6 08 FT	0 833+1 75*DEPTH OF FILL
LENGTH(PARALLEL TO SHORT)	12.92 FT	1 67+1.75*DEPTH OF FILL+
Wull	0.83 KIPS/FT	CC DIMEN of WHEELS(FT)
Pu	65 28 KIPS	

SHEAR ANALYSIS; SHORT DIRECTION

		NOTES:	
a	0 77 FT	50% OF WALL + d	ACI 11.1.3 1
b	5 73 FT	LOAD LENGTH	
c	0.00 FT	LOAD TO OTHER END	
TOTAL	6 50 FT	SPAN LENGTH	

Vu(ll)@"d"=%*(Wull)(b)((2c)+b)/2l	2.10 KIPS/FT	E=	1
Vu(dl)@"d"=Wudl(l/2-a)	1 60 KIPS/FT		
Vu@"d"=	9.70 KIPS	ACTUAL Vu PER FT	
b=	12 INCHES	WIDTH	OK
d=	6 19 INCHES		
0 85Vc=0.85*2*SQRT(f'c)*b*d	8 47 KIPS	ALLOW Vc PER FT	ACI 11 3 1 1

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input SIZE: 6' X 12'-6" X 7' 18-Sep

8 req'd **MOMENT/As IN LID:**

BASIC DATA

CONCRETE COVER TO REBAR 1 50 INCH

INSIDE VAULT WIDTH	6.00 FT	
INSIDE VAULT LENGTH	12.50 FT	
WALL THICKNESS	6 INCHES	
RATIO: LENGTH WIDTH	2.08	
ONE-WAY SLAB DESIGN:		
% OF LOAD IN SHORT DIRECTION	100 00%	AASHTO 3.24.6.1
% OF LOAD IN LONG DIRECTION	0.00%	AASHTO 3 24.6 1
SLAB THICKNESS	8 INCHES	AASHTO 3.24.6.1
SHORT SPAN LENGTH	6.50 FEET	
LONG SPAN LENGTH	13 00 FEET	

DEAD LOADS:

SLAB	0.140 KSF	
OVERBURDEN	0.504 KSF	
Wudl=	0 644 KSF	

LIVE LOAD

WHEEL LOADS(P)	32 KIPS	2 WHEELS
IMPACT	20%	AASHTO 3 8.2.3
WHEEL FOOTPRINT ON LID:		ASTM C857-87
WIDTH(PARALLEL TO LONG)	6.08 FT	0.833+1 75*DEPTH OF FILL
LENGTH(PARALLEL TO SHORT)	12.92 FT	1 67+1 75*DEPTH OF FILL+6FT
Wull	0.83 KIPS/FT	
Pu	65 28 KIPS	

Mid-span moment multiplicaton factor due degreee of fixity 100 00%

ANALYSIS OF 1' WIDE STRIP ACI 318-89 CHAPTER 10	SHORT SPAN	LONG SPAN	
a	0 00	3 46	END TO LOAD
b	6 50	6 08	LOAD LENGTH
c	0 00	3 46	LOAD TO OTHER END
SPAN LENGTH	6 50	13 00	FEET
%OF LOAD	100.00%	0 00%	
Rll(100% OF LOAD)	2.70	2 53	KIPS
Mull@l/2=(REDUCED by '% of LOAD')	4 39	0 00	E short= 1.00 E long= 1
Mudl@l/2=(REDUCED by '% of LOAD')	3.40	0 00	FT-KIPS AT MIDSPAN/FT WIDTH
Mu@l/2	7.78	0.00	FT-KIPS AT MIDSPAN/FT WIDTH
Mused@1/2	5.01	0 00	FT-KIPS AT MIDSPAN/FT WIDTH
b=	12	12	INCHES WIDTH OF STRESS BLOCK
d=	6.19	5 56	INCHES
As req'd (Neg indicates As min)	0.289	0 125	SQ INCHES(min or 133% of req'd or req'd)
As provided	0.409	0 262	SQ INCHES
input REBAR SIZE #	5	4	#
input REBAR SPACING	9	9	INCHES

CRACK CONTROL LONG WALL/INSIDE AASHTO 8 16 8 4

ZMAX	170 KIPS/INCH	
fs	25 97 KSI	
dc	1 81 INCHES	OK
A=(2*dc*bar spacing) PER BAR	32 63 SQ INCHES	
Z Actual=fs*(dc*A) ^0.3333	101 KIPS/INCH	

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no input SIZE 6' X 12'-6" X 7'

G

SHEAR ANALYSIS OF BOTTOM SECTION

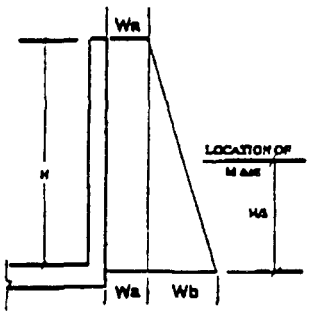
BASIC DATA

CONCRETE COVER TO REBAR: 2.69 INCH

INSIDE VAULT WIDTH	6.00 FT
INSIDE VAULT LENGTH	12.50 FT
WALL THICKNESS	6.00
INSIDE HEIGHT	7.00
TWO WAY WALL DESIGN:	
% OF LOAD IN CANTILEVER DIRECTIO	31.73%
% OF LOAD IN LONG WALL/BENDING	68.27%
SLAB THICKNESS	6.00 INCHES
SHORT SPAN LENGTH	6.50 FEET
LONG SPAN LENGTH	13.00 FEET
DEPTH TO TOP OF WALL	6.07 FEET
DEPTH TO BOTTOM OF WALL	13.07 FEET

ASSHTO 3.24.6.1

SOIL LOADING CONDITION



LATERAL SOIL PRESSURES:ultimate

Wa=	0.536 KSF
Wb@"d"=	0.592 KSF
Wb	0.619 KSF

SHEAR VALUES.@TOP OF BASE

x=SPAN-"d"	6.70 FT	
Vu@"d"=	1.77 KIPS	ACTUAL Vu PER FT
b=	12.00 INCHES	OK
d=	3.63 INCHES	
0.85Vc=0.85*2*SQRT(f'c)*b*d	4.96 KIPS	ALLOW.VcPER FT

SHEAR VALUES:@END OF LONG WALL

x=SPAN-"d"	12.00 FT		
Vu@"d"=	2.20 KIPS	ACTUAL Vu PER FT	ACI 11.1.3.1
b=	12.00 INCHES	OK	
d=	3.00 INCHES		
0.85Vc=0.85*2*SQRT(f'c)*b*d	4.11 KIPS	ALLOW VcPER FT	ACI 11.3.1.1

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input SIZE· 6' X 12 -6" X 7'

H req'd **MOMENT/As IN WALL OF BOTTOM SECTION**

input required on this sheet

INSIDE VAULT WIDTH	6.00 FT
INSIDE VAULT LENGTH	12.50 FT
WALL THICKNESS	6.00
INSIDE HEIGHT	7.00
TWO WAY WALL DESIGN	
% OF LOAD IN CANTILEVER DIRECTIO	31.73%
% OF LOAD IN LONG WALL/BENDING	68.27%
SLAB THICKNESS	6.00 INCHES
SHORT SPAN LENGTH	6.50 FEET
LONG SPAN LENGTH	13.00 FEET
DEPTH TO TOP OF WALL	6.07 FEET
DEPTH TO BOTTOM OF WALL	13.07 FEET

CONCRETE COVER TO REBAR
2.08 INCH

STIFFNESS METHOD. AASHTO 8.6
STIFFNESS METHOD..AASHTO 8 6
STIFFNESS METHOD AASHTO 8 6

LATERAL SOIL PRESSURES-ultimate

Wa=	0.536 KSF
Wb=(@H/2)	0.309 KSF

ANALYSIS OF 1' WIDE STRIP ACI 318-89 CHAPTER 10	CANT SPAN	BENDING LONG L	BENDING CORNER	+or-M BENDING SHORT L		
SPAN LENGTH	7.00	13.00		6.50	FEET	
%OF LOAD	31.73%	68.27%	68.27%	68.27%		
Mudl due to Wa	4.17	3.87	3.87	-1.93	FT-KIPS	PER FT OF WIDTH
Mudl due to Wb	1.60	2.23	2.23	-1.12	FT-KIPS	PER FT OF WIDTH
Mu=	5.77	6.10	6.10	-3.05	FT-KIPS	PER FT OF WIDTH
Mwsd=	3.40	3.59	3.59	-1.78	FT-KIPS	PER FT OF WIDTH
b=	12	12	12	12	INCHES	WIDTH
d=	3.63	3.00	3.00	3.00	INCHES	
As req'd (Neg indicates As min)	0.389	0.508	0.508	0.216	(min or 133% of req'd as req'd)	
check As provided	0.589	0.589	0.589	0.589	SQ INCHES	
input REBAR SIZE #	6	6	6	6	#	
input REBAR SPACING	9	9	9	9	INCHES	
	**	++	**	++		

** MUST HAVE REBAR INPUT WHEN CANTILEVER=100% see cell m196
++MUST HAVE REBAR SIZE=0 WHEN CANTILEVER=100% see cell m196

CRACK CONTROL LONG WALL/INSIDE AASHTO 8 16 8 4

Z MAX	170
fs=	22.99 KSI
dc=	2.44 INCHES
A=(2*dc*bar spacing) PER BAR	43.88 SQ-INCH
Z Actual=fs*(dc*A)^0.3333	198

OK

PAGE 5

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no input

SIZE 6' X 12'-6" X 7"

SHEAR ANALYSIS OF BASE SLAB OF BOTTOM SECTION

BASIC DATA

CONCRETE COVER TO REBAR: 1 50 INCH

INSIDE VAULT WIDTH	6 00 FT	
INSIDE VAULT LENGTH	12.50 FT	
WALL THICKNESS	6 00 INCHES	
RATIO: LENGTH WIDTH	2.08	
ONE-WAY SLAB DESIGN:		AASHTO 3.24 6 1
% OF LOAD IN SHORT DIRECTION	100.00%	AASHTO 3 24 6 1
% OF LOAD IN LONG DIRECTION	0.00%	AASHTO 3 24 6.1
SLAB THICKNESS	6 INCHES	
SHORT SPAN LENGTH	6 50 FEET	
LONG SPAN LENGTH	13 00 FEET	

DEAD LOADS:ultimate

VAULT	0 548 KSF
OVERBURDEN	0.504 KSF
Wudl=	1.052 KSF

LIVE LOAD.ultimate (Wull only) NOTES ASTM C857-87

WHEEL LOAD(P)(above lid)	32.00 KIPS	2 WHEELS
TRANSFERRED TO BASE(ultimate)	29.48 KIPS	6 08 W OF FOOTPRINT ON LID
IMPACT	0 00%	6.08 WMAX
DISTRIBUTION AREA	94 50 FT2	12.92 L OF FOOTPRINT ON LID
Wull=	0 31 KSF	7 00 LMAX

SHEAR ANALYSIS:SHORT DIRECTION

a=50% OF WALL + d	0 80 FT	50% OF WALL + d	ACI 11.1 3.1
Vu(dl)@"d"=%*Wudl*(l/2-a)	2 78 KIPS	SHORT SPAN	
Vu(ll)@"d"=%*(Wull)*(l/2-a)	0 83 KIPS	SHORT SPAN	
Vu@"d"=	3 62 KIPS	ACTUAL Vu PER FT	
b=	12 INCHES	WIDTH	OK
d=	4 19 INCHES		
0.85Vc=0 85*2*SQRT(f'c)*b*d	5 73 KIPS	ALLOW Vu PER FT	ACI 11 3 1 1

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input SIZE 6' X 12'-6" X 7"

J req'd **MOMENT/As IN BASE SLAB OF BOTTOM SECTION**

BASIC DATA

CONCRETE COVER TO REBAR: 1 50

INSIDE VAULT WIDTH	6 00 FT		
INSIDE VAULT LENGTH	12 50 FT		
WALL THICKNESS	6		
RATIO: LENGTH:WIDTH	2.08		
ONE-WAY SLAB DESIGN:	USED FOR	AASHTO 3 24 6.1	
% OF LOAD IN SHORT DIRECTION	100 00% MOMENT	AASHTO 3.24 6.1	
% OF LOAD IN LONG DIRECTION	0.00% MOMENT	AASHTO 3.24.6.1	
SLAB THICKNESS	6 INCHES		
SHORT SPAN LENGTH	6.50 FEET		
LONG SPAN LENGTH	13.00 FEET		

DEAD LOADS-ultimate

VAULT	0.548 KSF	37,013	LBS
OVERBURDEN	0 504 KSF		
Wudl=	1 052 KSF		

LIVE LOAD:ultimate (Wull only)

WHEEL LOAD(P)	32 KIPS	2 WHEELS
IMPACT	0%	AASHTO 3.8.2.3
DISTRIBUTION AREA	94 50 FT2	ASTM C857-87
Wull=	0 81 KSF	

ANALYSIS OF 1' WIDE STRIP ACI 318-89 CHAPTER 10	SHORT SPAN	LONG SPAN	Mid-span moment multiplication factor due degree of fixity: 100.00%	
SPAN LENGTH	6 50	13.00	FEET	
%OF LOAD	100 00%	0 00%		
				REACTION AT END/FT WIDTH
Mudl@l/2=	5 56	0 00	FT-KIPS	PER FT WIDTH
Mull@ l/2	1 65	0.00	FT-KIPS	PER FT WIDTH
Mu@l/2	7.21	0.00	FT-KIPS	PER FT WIDTH
Mwsd@l/2	4.94	0 00	FT-KIPS	PER FT WIDTH
b=	12	12	INCHES	WIDTH
d=	4 19	3 56	INCHES	
As req'd (Neg indicates As min)	0 408	0.125	SQ INCHES	(min of 133% of req'd or req'd)
check As provided	0.409	0 262	SQ INCHES	
input REBAR SIZE #	5	4	#	
input REBAR SPACING	9	9	INCHES	

CRACK CONTROL-LONG WALL/INSIDE AASHTO 8 16.8 4

Z MAX 170	170 KIPS/INCH	
fs	38.47 KSI	
check dc	1 81 INCHES	OK
A=(2*dc*bar spacing) PER BAR	32 83 SQ INCHES	
Z Actual=fs*(dc*A)^0.3333	150 KIPS/INCH	

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7. Structural Design Calculations for Carbon Steel Tank

Y-14 PALMER MFG

TANK DATA

10' DIA x 7'-2" SIDEWALL

VERTICAL

1'-6" OVERBURDEN

1/4" BOTTOM 5/16" TOP

1/4" SHELL

WITH TANK SETTING VERTICALLY BURIED, JOINT BETWEEN BOTTOM BAND & BOTTOM SEES:

8'-8" @ S.G. = 1.7 = 6.38 PSI

TOP WILL SEE: 1'-6" + LIVE LOAD = 1.97 PSI

SHELL DESIGN

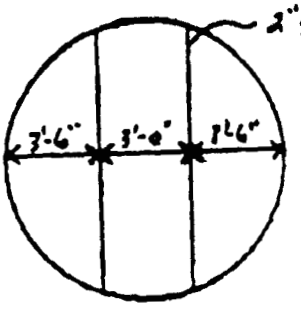
$\frac{L}{D_o} = \frac{86}{120} = .717$

$\frac{D_o}{t} = \frac{120}{.25} = 480$

A = .0002

$P_a = \frac{2(.0002)(30 \times 10^6)}{3(480)} = 8.33$ PSI. 1/4" SHELL IS OK

TOP DESIGN



a = 10'
h = 3'
a/h = 3.33
α = .1568

LOAD = 2.12 PSI

$y = \frac{.1568(2.12)(36^4)}{29 \times 10^6 (.3125)}$ y = .550" ACCEPTABLE

ANCHORAGE

TOTAL BOUYANT FORCE

F_B = 62.4 lb/ft³ (550 ft³) = 34,520 lbs ↑

REACTIONS AGAINST BOUYANCY

WEIGHT OF TANK - 4,990 lbs

1' LIP AROUND TANK - 39.6 ft² (8' DEEP) = 276.5 ft³

SOIL ON TOP OF TANK = 1' × (π × 5² − 4' × 5') = 58.5 ft³

~~276.5 ft² (62.4 lb/ft²)(1.5) = 40,700 lbs ↑~~

VOLUME OF WET SOIL = 276.5 + 58.5 = 337.0 ft³ HATCH

USE 90% = MAX WET DENSITY = 0.9 × 120 pcf = 108 pcf

WEIGHT OF WET SOIL = 337.0 × 108 = 36,396

BOUYANT FORCE - 34,520 lbs ↑

REACTIONS AGAINST - 4,990 lbs ↓

~~40,700 lbs ↓~~ 36,396 ↓

~~8,630 lbs ↑~~ 7,066 ↓ NET FORCE IS DOWNWARD.

~~TANK STILL REQUIRES ABOUT 10,000 lbs OF "DOWNWARD" REACTION TO COUNTER ACT THE ENTIRE BOUYANCY FORCE.~~

Rodlines
John Jankowsky
9/18/95

CONCLUSION:

BOTTOM & SIDEWALL TO BE 1/4"

TOP TO BE 5/16" w/ 2" × 2" × 1/4" BRACING

TOP & 18" DOWN SIDEWALL TO BE SPRAY FOAM INSULATED.

~~TANK REQUIRES ±10,000 lbs (IN ADDITION) TO RESIST FULL BOUYANT LOAD.~~

REFERENCES:

ROARKS FORMULAS FOR STRESS & STRAIN

PRESSURE VESSEL HANDBOOK

Scott
9-18-95

TOTAL P.04

SEP-18-1995 16:57 PALMER MFG & TANK P.01

Page No Of

Palmer MFG. & TANK INC. GARDEN CITY, KANSAS

DATE.
Proposal No.
Proposal Good For:
Customer Inq. No:
Customer Ref.
Estimated Delivery:
F.O.B. Point:
Terms:

4 PAGES

Jr. Mgr/Chief Engr

ATTN: JOHN JANKOUSKY @ STOLLER

CUSTOMER PHONE ... DELIVERY RECEIVED

JOB NAME—

JOB LOCATION—

JOB PHONE—

THIS QUOTATION IS SUBJECT TO ALL PROVISIONS AND CONDITIONS ON THE REVERSE SIDE INCLUDING THOSE LIMITING WARRANTIES.

☐ P O. BOX 1195 WEST HIWAY 50 [316] 275-7461
GARDEN CITY, KANSAS 67846

Quantity	Description	Unit Price	Total Pr
1	10 dia x 7'-H, 4000 gal, vertical, flat bottom (12' dia) closed flat top, unpainted steel tank with insulated top, for 12" fall burial depth below grade		[redacted]
	Tank constructed of 1/4" A-36 carbon steel bottom and sidewall with 5/16" top with 2 - 2"x2"x1/4" angle stiffeners. Top will be insulated with 2" thick foam insulation coated with fiberglass shell		
	Tank will be fitted with 1 - 2" threaded outlet 3 - 4" " " 1 - 12"x12"x4" sump 1 - 48"x48" flanged bottom inlet with internal fall tube portable water spray		

By _____

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F.O.B. Point.

Terms

CUSTOMER PHONE | DATE INQUIRY RECEIVED

JOB NAME--

JOB LOCATION--

JOB PHONE--

THIS QUOTATION IS SUBJECT TO ALL PROVISIONS AND CONDITIONS ON THE REVERSE SIDE INCLUDING THOSE LIMITING WARRANTIES.

☐ P.O. BOX 1195 WEST HIWAY 50 (316) 275-7461
GARDEN CITY, KANSAS 67846

Quantity	Description	Unit Price	Total Pri
	4 Stress relieving type coated with coal tar epoxy Light Legs		
1	Freight to Denver area		
	Note: Tank requires recommended additional bracing assistance. No provisions is made in this quote to provide it.		

By _____

Toll Free 1-800-835-9136
Outside State of Kansas

SEP 18 '95 16 38 303 526 0449 PAGE 001

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Welds

Bottom to sidewall
1/4"fillet weld each side

Top to sidewall
Inside 1/4" fillet weld, outside corner modified 1/4" butt weld

All other
Full penetration 1/4" butt weld welded one-half way from each side

8. Uplift Calculations for Concrete Vault

Weight of Concrete Tank Compared to Uplift from Displaced Water					
Weight of Concrete Tank (lbs	Length (ft)	Width (ft)	Depth (ft)	Volume of Displaced Water (ft^3)	Weight of Displaced Water (lbs)
40,000	13	7	8	728	45,427
Calculate Depth of displaced water so that weight of displaced					
water equals weight of tank.					
	13	7	7 0	641 0	40,000
Weight of Concrete tank alone can prevent uplift from 7 0 feet					
of groundwater up tank side Before tank is filled, water level					
must be kept below 7 0 feet above tank bottom					
Calculate weight of water in tank					
	Length, inside (ft)	Width, inside (ft)	Depth to Outflow Invert, inside (ft)	Volume of Water in Tank (ft^3)	Weight of Water in Tank (lbs)
	12	6	5 5	396 0	24,710
Weight of Concrete Tank (lbs	Weight of Water in Tank (lbs)	Weight of Tank + Water in Tank (lbs)			
40,000	24,710	64,710			
Once tank is full, weight of tank and water in tank is much					
greater than weight of water displaced					
Assume					
Density of water =			62 4	lbs/ft^3	

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9. Uplift Calculations for Carbon Steel Tank

Calculation of Soil Load Compared to Uplift from Displaced Water for Steel Tank						
For Steel Tank with 1 foot flange around bottom perimeter (see figure)						
Diameter of Tank (ft)	Height of Tank, H (ft)	Volume of Water Displaced, V_w (ft^3)	Diameter of Flange (ft)	Volume of Soil in Volume A, V_{sA} (ft^3) (calculated below)	Volume of Soil in Volume B, V_{sB} (ft^3) (calculated below)	Volume of soil on top of tank and flange, Volume C (ft^3) (one foot of cover) = pi * 6^2 - (4 x 5)
10	7	550	12	242	552	93
Description	Volume	Density	Downward force (Uplift)			
Water Displaced	550	62 4	-34,306			
Soil A	242	108	26,126			
Soil B	552	108	59,574			
Soil C	93	108	10,055			
Weight of Tank			4,990			
SUMMATION			66,438			
Weight of displaced water is much less than combined weight of downward forces						
This calculation ignores the weight of the tank contents						
Assume						
Density of water =			62 4	lbs/ft^3		
Density of saturated soil =			108	lbs/ft^3	(120 pcf * 0 90)	
Uplift is resisted by soil directly above flange (volume A)						
and soil in a "cone" with a slope of 2 1 (vert:horiz) (volume B)						
and by soil overburden of 1 foot (volume C)						
and weight of tank						

With saturation to ground surface, V_w = volume of cylinder = pi * (r ^ 2) * H

Weight of water or soil = volume * density

For Volume A

V_{sA} = pi * (radius outer ^ 2 - radius inner ^ 2) * H

For Volume B

dV = pi * r ^ 2 * dy

for 30 degree angle cone, r = 0 5 * y

therefore, dV = pi * 0 25 * y ^ 2 * dy

Integrate both sides, integrate dy from y to 0

V = pi * 0 25 * (y ^ 3)/3

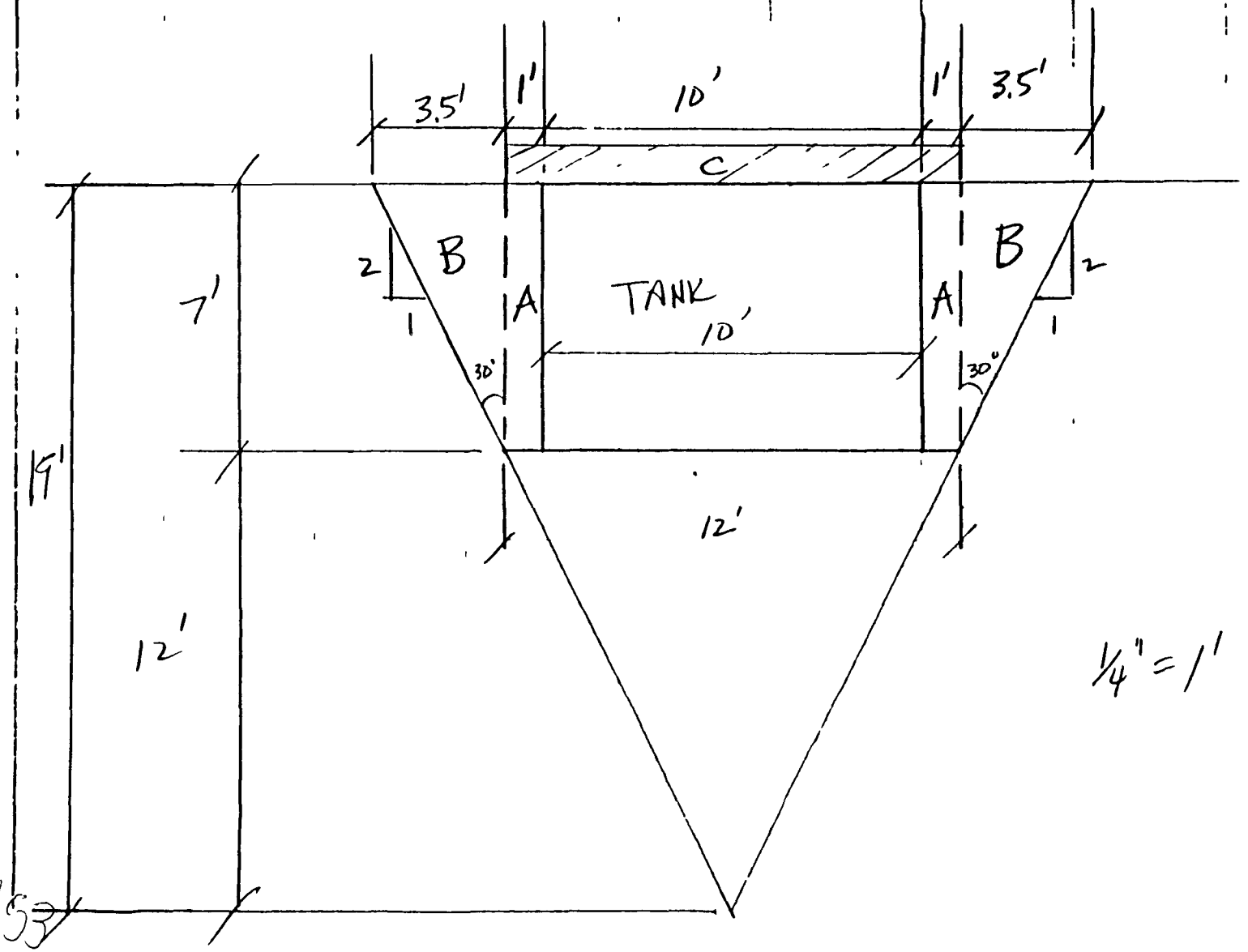
V_{sB} = volume of 19 foot high cone - volume of 12 foot high cone - volume of 12 foot dia x 7 ft cylinder

V_{sB} (ft^3)	Volume of 19 foot high cone (ft^3)	Volume of 12 foot high cone (ft^3)	Volume of 12 foot dia x 7 foot high cylinder (ft^3)
552	1796	452	792

Stoller

8/23/95
Out Passive Treatment
JLJ

Steel Tank geometry for Uplift Calculations



1/4" = 1'

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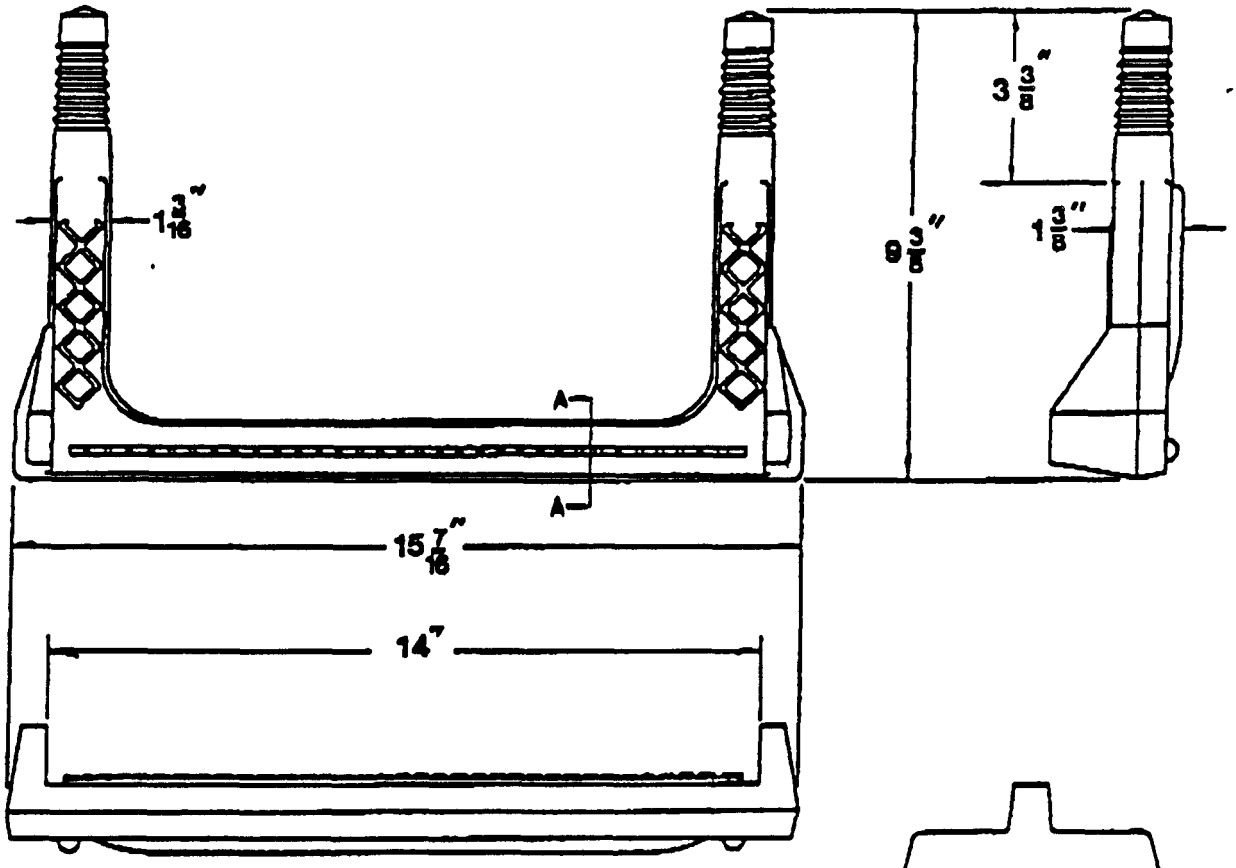
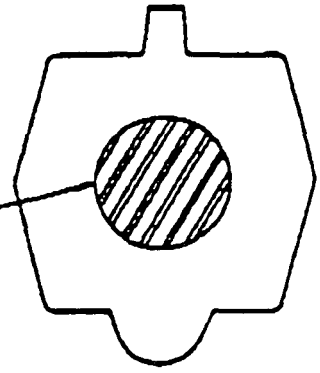
10. Product Specification Sheet for Manhole Step

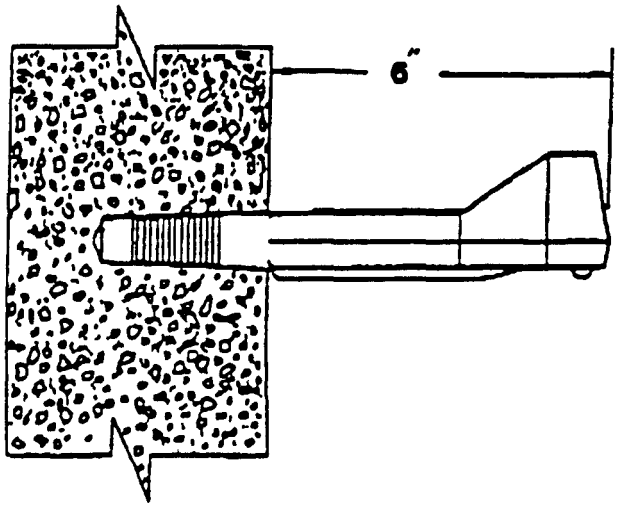


Copolymer Polypropylene Plastic

½" GRADE 60 STEEL REINFORCEMENT



SECTION-A



PS2-PF

Manhole Step

M.A. Industries Inc.
Kelley & Dividend Dr.
Peachtree City Ga.

2-6-87

11. Product Specification Sheets and Design Calculations for Link Seal Gaskets

Link Seal Gasket Sizing

Penetration Number	Description	Pipe Size, O D (in)	Penetration Size (in)	Link-Seal Size No	Links per Seal *	Source	For Non-Standard Diameters: Annular Space (in)	Bolt Circle	Link Calculation
1	3" Schedule 80 PVC Collection Pipe into Settling Tank	3 5	5	LS-300	8	Table, p 9			
2	Vent Pipe (3" PVC) into Settling Tank	3 5	5	LS-300	8	Table, p 9			
3	3" PVC Pipe for High-Level Indicator in Settling Tank	3 5	5	LS-300	8	Table, p 9			
4	3 x 2 PolyFlo Pipe outflow for Settling Tank	3 035	5	LS-315	8	pp 12-13	0 9825	4 0175	8 3542715
5	3 x 2 PolyFlo Pipe inflow for Treatment Tank	3 035	5 047	LS-315	8	pp 12-13	1 006	4 041	8 4031391
6	2" Schedule 80 PVC Outflow Pipe for Treatment Tank	2 375	4 026	LS-300	6	Table, p 9			

* When using calculation method for non-standard diameters on pp 12-13, round the result of "Link Calculation" down to the nearest integer

All Link-Seal gaskets shall be Model C, Type Standard, Seal Element EPDM Black, pressure plates composite, bolts and nuts steel zinc dichromate, temperature range (°F) -40 to + 250

LINK-SEAL® SELECTION GUIDE

Simple 4-step method

For most applications, Link-Seal can be selected from the charts on pages 9, 10 and 11 (If your pipe and wall opening dimensions do not appear here,use the methods on pages 12 and 13)

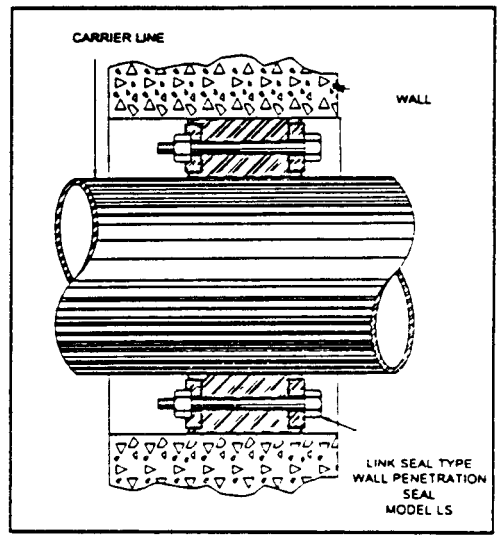
1. There are 6 charts. Find the chart that applies and locate your pipe size.

2. Determine the type of wall opening to be used: CS Plastic sleeve, WS steel sleeve or core drilled hole.

3. Begin at column heading "Nominal Pipe Size". Then read across to the sizing section for CS plastic or WS steel sleeves or core bit drilled holes. The first column identifies the sleeve model or hole diameter .. the second column is the Link-Seal size number and the third column is the number of links required for a complete seal assembly.

4. To order, add the Link-Seal model.

Select the model you require from the chart below Include the model letter designation with the sizing information, as in this example Links per seal - 10, Link-Seal size number - LS-300, Model - C Thus your order would read 10 LS-300-C



LINK SEAL MODELS

MODEL	TYPE	SEAL ELEMENT	PRESSURE PLATES	BOLTS & NUTS	TEMPERATURE RANGE (°F)	APPLICATIONS
C	Standard	EPDM Black	COMPOSITE	STEEL zinc dichromate	40 to + 250	Suitable for use in water direct ground burial and atmospheric conditions Provides electrical insulation where cathodic protection is required
S	Stainless	EPDM Black	COMPOSITE	STAINLESS STEEL (18 8)	-40 to + 250	For chemical processing waste water treatment EPDM rubber is resistant to most inorganic acids and alkalis some organic chemicals (acetone alcohol ketones)
O	Oil resistant	NITRILE Green	COMPOSITE	STEEL zinc dichromate	40 to + 210	Nitrile rubber is resistant to oils fuel and many solvents (gasoline motor oil kerosene methane jet fuel hydraulic fluid water etc)
OS	Oil resistant	NITRILE Green	COMPOSITE	STAINLESS STEEL (18 8)	-40 to + 210	Combination of oil resistant rubber and stainless steel hardware
T	High/low temperature	SILICONE Grey	STEEL zinc dichromate	STEEL zinc dichromate	67 to + 400	Silicone rubber is ideal for temperature extremes "T" model is Factory Mutual approved
FD/ FS	Fireseals	SILICONE Grey	STEEL zinc dichromate	STEEL zinc dichromate	67 to + 400	Double seal three hour fire rated barrier (ANI approved)
M	Non insulating	EPDM Black	STEEL	STEEL zinc dichromate	40 to + 250	Commonly specified for a wide range of applications where cathodic protection is not required
TC	High temperature insulating	SILICONE Grey	STEEL Epoxy Coating	STEEL zinc dichromate	67 to + 400	High temperature applications where cathodic protection is required

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LINK-SEAL® SIZING CHARTS FOR STANDARD DIAMETER PIPE

DUCTILE IRON PIPE (AWWA-TYPE)

PIPE SIZE (NOMINAL)	ACTUAL OUTSIDE DIAMETER (O D)	CS MODEL PLASTIC SLEEVE			WS MODEL STEEL SLEEVE			CAST OR CORE BIT DRILLED HOLE		
		PLASTIC SLEEVE MODEL	LINK-SEAL SIZE NO **	LINKS PER SEAL	STEEL SLEEVE MODEL	LINK-SEAL SIZE NO **	LINKS PER SEAL	HOLE I D	LINK-SEAL SIZE NO **	LINKS PER SEAL
2	2 500	CS-4-*	LS-300	6	WS-4-23-S-*	LS-300	6	4 000	LS 300	6
2-1/4	2 750	CS-5-*	LS-325	4	WS-5-25-S-*	LS-325	4	5 000	LS-325	5
3	3 960	CS-6-*	LS-325	5	WS-6-28-S-*	LS-325	5	6 000	LS-325	5
4	4 800	CS-8-*	LS-400	5	WS 8-32-S-*	LS-400	5	8 000	LS-400	5
6	6 900	CS-10-*	LS-400	7	WS-10-36-S-*	LS-400	7	10 000	LS-400	7
8	9 050	CS-12-*	LS-400	9	WS-12 37 S-*	LS-400	9	12 000	LS-400	9
10	11 100	CS-14-*	LS-400	11	WS 14-37 S *	LS-325	12	14 000	LS-400	10
12	13 200	CS-16-*	LS-400	12	WS 16-37-S-*	LS-325	14	16 000	LS-425	12
14	15 300	CS-18-*	LS-325	16	WS-18 37-S-*	LS-325	16	18 000	LS-425	14
16	17 400	CS-22-*	LS-400	16	WS-20 37 S-*	LS-325	18	20 000	LS-425	16
18	19 500	CS-24*	LS-400	18	WS-24-37 S-*	LS-475	25	24 000	LS-525	17
20	21 600	CS-25-*	LS-400	20	WS-27 37-S-*	LS-525	19	26 000	LS-525	19
24	25 800	N/A	—	—	WS 30 37-S-*	LS-400	23	30 000	LS-575	28
30	32 000	N/A	—	—	WS 38 37 S *	LS-500	27	36 000	LS-575	34
36	38 300	N/A	—	—	WS-44 1/2 37 S-	LS 500	33	43 000	LS-525	33
42	44 500	N/A	—	—	WS-50 1/2 37 S *	LS 500	38	49 000	LS-525	38
48	50 800	N/A	—	—	WS 57-37 S-*	LS 500	43	56 000	LS 500	43
COPPER TUBING										
1/2	625	CS-2-*	LS-275	4	WS-2 15-S	LS 275	4	2 000	LS-275	4
3/4	875	CS-3-*	LS-315	4	WS-2 15-S	LS-200	4	2 000	LS-200	4
1	1 125	CS-3-*	LS-300	4	WS 2 1/2 20 S	LS-275	5	3 000	LS-315	4
1-1/4	1 375	CS-3-*	LS-300	4	WS-3 21 S	LS 300	4	3 000	LS 300	4
1-1/2	1 625	CS-3-*	LS-200	6	WS-3 21 S	LS-275	7	3 000	LS 275-	7
2	2 125	CS-3-1/2-*	LS-200	7	WS 3 1/2 22 S-	LS 275	8	3 500	LS-275	8
2 1/2	2 625	CS-4-*	LS-275	10	WS-4 23-S	LS 275	10	4 000	LS-275	10
3	3 125	CS-5-*	LS-325	4	WS-5 25 S-	LS 325	4	5 000	LS 325	4
4	4 125	CS-6 *	LS-325	5	WS-6 28-S	LS 325	5	6 000	LS 325	5
6	6 125	CS-8 *	LS-325	7	WS-8 32 S	LS 325	7	8 000	LS 325	7
8	8 125	CS-10*	LS 325	9	WS-10 36 S	LS-325	9	10 000	LS 325-	9
10	10 125	CS 12	LS 325	11	WS 14 37 S	LS-400	10	14 000	LS-475	14
12	12 125	CS-14 *	LS 325	13	WS-16 37 S *	LS-400	12	16 000	LS-475	16

Specify sleeve length in inches

* *Specify model when ordering*

2 x 3 double-rnt
pipe OD = 3.035
2" pipe = OD = 2.375
3" Pipe = OD = 3.500

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CALCULATION METHOD FOR NON-STANDARD DIAMETERS

If your pipe size does not appear in the charts on pages 9, 10 or 11, use this method to select Link-Seal.

First, calculate the Annular Space in order to select your Link-Seal size from the chart on this page. Then determine the number of links required to go around the pipe. Here's how:

Step A

The Annular Space is half the difference between your pipe size and the wall opening diameter Use this formula

$$\text{Annular Space} = \frac{\text{Wall Opening} - \text{Pipe Diameter}}{2}$$

Step B

Now go to Link-Seal Dimensional Chart #1 Select the size closest to the Annular Space just calculated You have selected the correct size Link-Seal if the Free State Thickness is less than the Annular Space and the Expanded State Thickness is greater than the Annular Space

Step C

Next calculate how many links are required to fit around the pe and seal the Annular Space This is a 3-part calculation First determine the Bolt Circle for your Link-Seal assembly This is simply the mid-point of the Annular Space

$$\text{Bolt Circle} = \frac{\text{Wall Opening} + \text{Pipe Diameter}}{2}$$

Step D

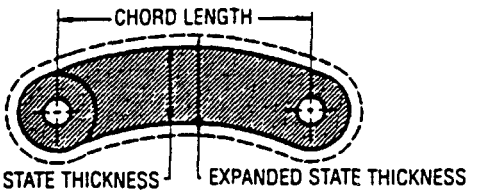
Second, determine the number of links needed for your assembly To do this, find the Chord Length of your Link-Seal size — in the right-hand column of Chart #1 Then multiply the Bolt Circle by 3 14 and divide by the Chord Length

$$\text{Links Per Seal} = \frac{\text{Bolt Circle} \times 3.14}{\text{Chord Length}}$$

Always round up

Finally, the result must be rounded down to the next whole number This completes your calculation Now refer to page 8 and select a model designation IMPORTANT If the Step D calculation results in 10 or more links it is accurate If it indicates fewer than 10 links refer to the next page to verify your calculations

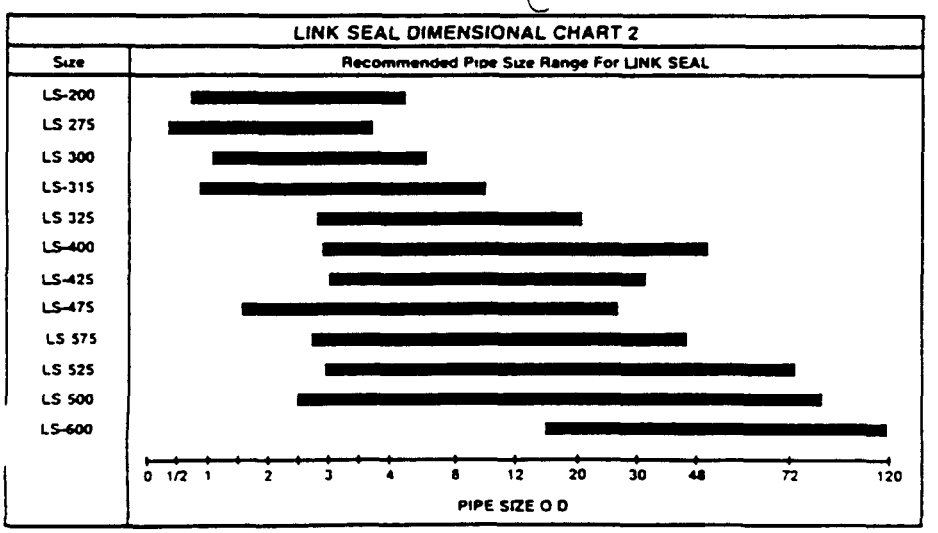
LINK-SEAL DIMENSIONAL CHART 1

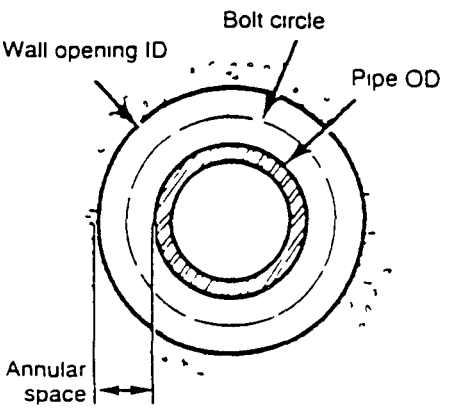


	SEALING RANGE		
SIZE	FREE STATE THICKNESS*	EXPANDED STATE THICKNESS	CHORD LENGTH
LS-200	50"	62"	1 125"
LS-275	62"	78"	0 910"
LS-300	71"	88"	1 510"
LS-315	82"	1 03	1 470"
LS 325	94"	1 18"	3 100"
LS-400	1 43	1 81"	3 625"
LS 425	1 13"	1 45	3 625
LS-475	1 62"	1 90"	2 625
LS 500	2 37"	2 81	3 860
LS 525	2 18	2 50	3 860
LS 575	1 81	2 35	3 100
LS 600	3 20	4 00"	6 000

**Free state thickness includes an insertion tolerance and therefore differs from the actual thickness as listed in Link Seal technical data on page 19*

LINK SEAL DIMENSIONAL CHART 2





LINK-SEAL® SIZING CHARTS FOR STANDARD DIAMETER PIPE

STEEL AND PLASTIC PIPE WITH SAME OUTSIDE DIAMETER

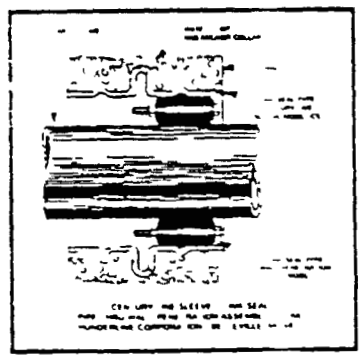
PIPE SIZE (NOMINAL)	ACTUAL OUTSIDE DIAMETER (O D)	CS MODEL PLASTIC SLEEVE			WS MODEL STEEL SLEEVE			CAST OR CORE BIT DRILLED HOLE		
		PLASTIC SLEEVE MODEL	LINK-SEAL SIZE NO **	LINKS PER SEAL	STEEL SLEEVE MODEL	LINK-SEAL SIZE NO	LINKS PER SEAL	HOLE I D	LINK-SEAL SIZE NO **	LINKS PER SEAL
1/2	840	CS-2-*	LS-200	4	WS 2 15 S-*	LS 200	4	2 000	LS-200	4
3/4	1 050	CS-3-*	LS-300	4	WS 2 1/2-20 S-*	LS 275	5	2 500	LS-275	5
1	1 315	CS-3-*	LS-300	4	WS-2-1/2-20-S-*	LS 200	5	3 000	LS-300	4
1-1/4	1 660	CS-3-*	LS-200	6	WS-3 21-S-*	LS 275	7	3 000	LS 275	7
1-1/2	1 900	CS-3-1/2-*	LS-275	8	WS 3 1/2-22-S-*	LS 300	5	3 500	LS-300	5
2	2 375	CS-4-*	LS-300	6	WS-4-23-S-*	LS 300	6	4 000	LS 300	6
2-1/2	2 875	CS-4	LS-200	9	WS-4 23 S-*	LS 200	9	4 000	LS-200	9
3	3 500	CS-5-*	LS-300	8	WS-5-25-S-*	LS 300	8	5 000	LS-300	8
3-1/2	4 000	CS-6-*	LS-325	5	WS-6 28 S-*	LS 325	5	6 000	LS-325	5
4	4 500	CS-6-*	LS-300	10	WS-6-28 S*	LS 300	10	6 000	LS 300	10
5	5 563	CS-8-*	LS-425	6	WS 8 32 S-*	LS-425	6	8 000	LS-425	6
6	6 625	CS-10-*	LS-475	10	WS 10 36-S *	LS-475	10	10 000	LS-475	10
8	8 625	CS-12-*	LS-475	12	WS 12 37 S	LS-475	12	12 000	LS-475	12
10	10 750	CS-14-*	LS-400	10	WS 14 37 S-*	LS-425	10	14 000	LS-400	10
12	12 750	CS-16-	LS-400	12	WS 16 37-S-*	LS-475	12	16 000	LS-400	12
14	14 000	CS-18-*	LS-400	13	WS 18 37 S	LS-400	13	18 000	LS-575	16
16	16 000	CS-20-*	LS-400	15	WS 20 37 S	LS 400	15	20 000	LS-575	18
18	18 000	CS-24-*	LS-525	16	WS 24 37 S	LS 500	16	22 000	LS-575	20
20	20 000	CS-25-*	LS-525	18	WS 24 37 S	LS-400	18	24 000	LS-575	22
22	22 000	CS-25-*	LS-425	20	WS 26 37 S *	LS-400	20	26 000	LS-575	24
24	24 000	N/A	—	—	WS 30 37 S	LS 500	21	28 000	LS-575	26
26	26 000	N/A	—	—	WS 30 37 S *	LS-400	23	30 000	LS 575	28
28	28 000	N/A	—	—	WS 34 37 S	LS 500	24	32 000	LS-575	30
30	30 000	N/A	—	—	WS 36 37 S *	LS 500	26	34 000	LS-575	32
32	32 000	N/A	—	—	WS 38 37 S	LS 500	27	36 000	LS 575	34
34	34 000	N/A	—	—	WS-40 37 S-*	LS 500	29	38 000	LS 575	36
36	36 000	N/A	—	—	WS 42 37 S	LS 500	30	40 000	LS-575	38
42	42 000	N/A	—	—	WS 48 37 S	LS 50	36	46 000	LS-575	44
48	48 000	N/A	—	—	WS 54 37 S	LS 50	41	52 000	LS-575	50

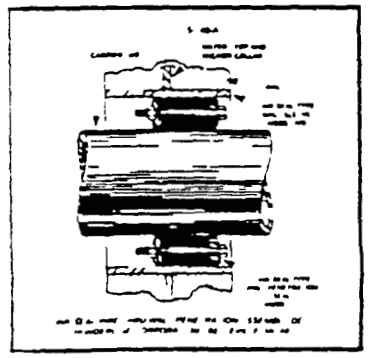
Specify sleeve length in inches
Specify model when ordering

ENGINEERING DECALS

These LINK-SEAL design decals are yours for the asking They simplify your drawings and assure proper ordering procedure

(Shown at reduced size
Actual decal measures
3 1/4 x 3 1/2")





LINK-SEAL® SIZING CHARTS FOR STANDARD DIAMETER PIPE

CAST IRON SOIL PIPE (EXTRA HEAVY)

PIPE SIZE (NOMINAL)	ACTUAL OUTSIDE DIAMETER (O D)	CS MODEL PLASTIC SLEEVE			WS MODEL STEEL SLEEVE			CAST OR CORE BIT DRILLED HOLE		
		PLASTIC SLEEVE MODEL	LINK-SEAL SIZE NO **	LINKS PER SEAL	STEEL SLEEVE MODEL	LINK-SEAL SIZE NO **	LINKS PER SEAL	HOLE I D	LINK-SEAL SIZE NO **	LINKS PER SEAL
2	2 380	CS-4-*	LS-300	6	WS-4-23-S-*	LS 300	6	4 000	LS 300	6
3	3 500	CS-5-*	LS-300	8	WS 5-25-S-*	LS 300	8	5 000	LS-300	8
4	4 500	CS-6-*	LS-300	10	WS-6-28-S-*	LS-300	10	6 000	LS-300	10
5	5 500	CS-8-*	LS-425	6	WS-8-32-S-*	LS-425	6	8 000	LS-425	6
6	6 500	CS-10-*	LS-475	10	WS-10-36-S-*	LS-475	10	10 000	LS-475	10
8	8 620	CS-12-*	LS-475	12	WS-12-37-S-*	LS-475	12	12 000	LS-475	12
10	10 750	CS-14-*	LS-400	10	WS-14 37-S-*	LS-425	10	14 000	LS-400	10
12	12 750	CS-16-*	LS-400	12	WS-16-37-S-*	LS-425	12	16 000	LS-400	12
15	15 880	CS-20-*	LS-400	15	WS-20-37 S*	LS-400	15	20 000	LS-575	18
CAST IRON SOIL PIPE (SERVICE WEIGHT)										
2	2 300	CS-4-*	LS-300	6	WS-4 23 S-*	LS-300	6	4 000	LS-300	6
3	3 300	CS-5-*	LS-315	8	WS 5 25 S-*	LS-315	8	5 000	LS-315	8
4	4 300	CS-6-*	LS-315	11	WS-6-28-S-*	LS 315	10	6 000	LS-315	10
5	5 300	CS-8-*	LS-425	6	WS-8 32 S-*	LS-425	6	8 000	LS-425	6
6	6 300	CS-8-*	LS-325	7	WS 10-36 S-*	LS-475	10	10 000	LS-475	10
8	8 380	CS-12-*	LS-475	12	WS 12 37 S-*	LS-475	12	12 000	LS-475	12
10	10 500	CS-14-*	LS-475	15	WS-14 37-S-	LS-425	10	14 000	LS-475	14
12	12 500	CS-16-*	LS-475	17	WS-16 37 S-*	LS 425	12	16 000	LS-475	17
15	15 620	CS-20-*	LS-475	21	WS 20 37 S*	LS-475	21	20 000	LS-525	14
ELECTRICAL METALLIC TUBING (THIN WALL)										
1/2	706	CS-2-*	LS-200	4	WS-2 15 S-	LS-275	4	2 000	LS 275	4
3/4	922	CS-3-*	LS-315	4	WS 2 15 S *	LS-200	4	2 000	LS-200	4
1	1 163	CS-3-*	LS-300	4	WS 3 21 S-	LS-315	4	3 000	LS-315	4
1-1/4	1 510	CS-3-1/2 *	LS-315	5	WS 3 21 S-*	LS 300	4	3 000	LS-300	4
1-1/2	1 740	CS-3-1/2-*	LS-300	5	WS 3 1/2 22 S-	LS 315	5	3 500	LS-315	5
2	2 197	CS-4-*	LS-315	6	WS-4 23 S	LS 315	6	4 000	LS-315	6
2 1/2	2 875	CS-4-*	LS-200	9	WS-4 23 S	LS 200	9	4 000	LS-200	9
3	3 500	CS-5-*	LS-300	8	WS 5 25 S	LS 300	8	5 000	LS 300	8
4	4 500	CS-6-*	LS 300	10	WS 6 28 S	LS 300	10	6 000	LS-300	10

Specify sleeve length in inches

Specify model when ordering

CHART METHOD FOR NON-STANDARD DIAMETERS

This page is needed for approximately 3% of all applications. It helps you select Link-Seal when you can't find your pipe size in the standard charts and when your calculation results in fewer than 10 links.

You already have the Link-Seal size and quantity from the calculation on the previous page You also know the wall opening dimension This chart will confirm whether or not the selected Link-Seal will fit correctly into the opening

Here's how to use it

Go to the chart for the Link-Seal size already determined (LS-200, LS-300, etc)

Compare the pipe size you are using with Pipe O D Range #1 or #2 Depending on which range your size falls into, follow the directions at the top of the column.

The chart gives you minimum and maximum wall opening dimensions If your wall opening size falls between the minimum and maximum wall opening sizes calculated from the chart, it is correct

The chart also gives you the number of links required for your assembly (on the same line as your pipe O D)

If your wall opening size is not in the range indicated by the chart, either choose another Link-Seal size change your wall opening size, or call us for assistance

EXAMPLE:

If your Link-Seal size is LS-300

And if your pipe is 2 900

You locate it in Range #2 on the LS-300 chart

The minimum wall opening is 2 900 (the pipe size plus 1 437 from col B or 4 337

The maximum wall opening is 2 900 plus 1 750 from Col C or 4 65

The number of links is 7 (on the same line as the pipe O D range) To select simply state the number of links the Link-Seal size and the model number chosen from the chart on page 8

PIPE O D RANGE # 1 MIN WALL OPENING = A MAX WALL OPENING = PIPE O D + C	PIPE O D RANGE # 2 MIN WALL OPENING = PIPE O D + B MAX WALL OPENING = PIPE O D + C	A MINIMUM WALL OPENING FOR PIPE O D IN RANGE #1	B MINIMUM WALL OPENING ADD ON FACTOR FOR PIPE IN RANGE # 2	C MAXIMUM WALL OPENING ADD ON FACTOR	LINKS PER SEAL
LS-200 SIZING CHART					
687 937	937 - 1 125	1 93	1 0	1	4
1 125 1 375	1 375 - 1 500	2 375	1 00	1 2	5
1 625 - 1 875	1 875 - 1 937	2 875	1 00	1 2	6
2 000 - 2 125	2 125 - 2 375	3 125	1 00	1 2	7
2 375 - 2 500	2 500 - 2 812	3 500	1 00	1 2	8
2 687 - 2 812	2 812 - 3 125	3 812	1 00	1 25	9
3 125 - 3 375	3 375 - 3 625	4 375	1 00	1 25	10
LS-275 SIZING CHART					
580 - 660	660 - 720	1 870	1 220	1 560	4
830 940	940 - 1 050	2 220	1 280	1 560	5
1 070 - 1 220	1 220 - 1 370	2 530	1 320	1 560	6
1 300 - 1 480	1 480 - 1 660	2 850	1 360	1 560	7
1 570 - 1 780	1 780 - 2 000	3 150	1 400	1 560	8
1 770 - 2 030	2 030 - 2 280	3 460	1 420	1 560	9
2 050 - 2 330	2 330 2 620	3 750	1 420	1 560	10
LS-300 SIZING CHART					
1 125 - 1 312	1 3 2 1 437	2 875	1 562	1 750	4
1 562 - 1 875	1 875 2 000	3 312	1 437	1 75	5
2 062 2 375	2 3 5 2 687	3 812	1 437	1 75	6
2 562 - 2 875	2 875 3 125	4 312	1 437	1 75	7
3 062 3 375	3 375 3 812	4 812	1 437	1 75	8
3 562 3 937	3 937 4 125	5 312	1 374	1 750	9
4 000 4 375	4 375 4 750	5 750	1 374	1 750	10
LS-315 SIZING CHART					
870 995	995 1 065	2 930	1 920	2 060	4
1 260 1 545	1 545 1 670	3 320	1 780	2 060	5
1 670 2 070	2 070 2 260	3 730	1 660	2 060	6
2 140 2 575	2 575 2 820	4 200	1 62	2 060	7
2 270 3 025	3 02 3 330	4 700	1 66	2 060	8
2 740 3 485	3 48 3 800	5 190	1 70	2 060	9
3 610 3 940	3 94 4 260	5 675	1 72	2 060	10
LS-325 SIZING CHART					
2 875 2 875	2 875 3 125	5 250	2 375	2 375	4
3 625 4 000	4 000 4 250	6 000	2 000	2 375	5
4 625 5 000	5 000 5 250	7 000	2 000	2 375	6
5 625 6 000	6 000 6 500	8 000	2 000	2 375	7
6 625 7 000	7 000 7 625	9 000	2 000	2 375	8
7 625 8 000	8 000 8 625	10 000	2 000	2 375	9
8 625 9 000	9 000 9 625	11 000	2 000	2 375	10
LS-400 SIZING CHART					
2 875 2 875	2 875 3 500	6 500	3 625	3 625	4
3 875 4 250	4 250 4 750	7 500	3 250	3 625	5
5 000 5 250	5 250 6 125	8 625	3 375	3 625	6
6 125 6 500	6 500 7 250	9 750	3 250	3 625	7
7 250 7 875	7 875 8 500	10 875	3 000	3 625	8
8 375 9 125	9 125 9 750	12 000	2 875	3 625	9
9 500 10 250	10 250 11 250	13 125	2 875	3 625	10
10 625 11 370	11 370 12 125	14 250	2 875	3 625	11
11 750 12 500	12 500 13 375	15 375	2 875	3 625	12

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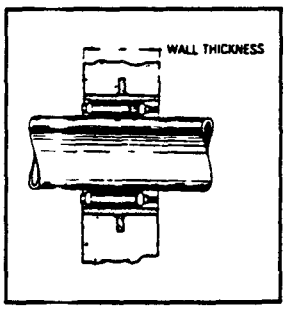
CHART METHOD FOR NON-STANDARD DIAMETERS

PIPE O D RANGE # 1 MIN WALL OPENING = A MAX WALL OPENING = PIPE O D + C	PIPE O D RANGE # 2 MIN WALL OPENING = PIPE O D + B MAX WALL OPENING = PIPE O D + C	A MINIMUM WALL OPENING FOR PIPE O D IN RANGE #1	B MINIMUM WALL OPENING ADD-ON FACTOR FOR PIPE IN RANGE #2	C MAXIMUM WALL OPENING ADD ON FACTOR	LINKS PER SEAL
LS-425 SIZING CHART					
3 00 - 3 500	3 500 -3 500	6 000	2 500	3 000	4
4 125 - 4 500	4 500 - 4 875	7 125	2 625	3 000	5
5 250 - 5 750	5 750 - 6 250	8 250	2.500	3 000	6
6 500 - 7 000	7 000 - 7 500	9 500	2.500	3 000	7
7 625 8 250	8 250 - 8 750	10 750	2.500	3 000	8
8 750 - 9 250	9 250 10 000	11 750	2.500	3 000	9
9 875 - 10 500	10 500 - 11 000	12 875	2 375	3 000	10
10 937 11 562	11 562 - 12 187	13 937	2.375	3 000	11
12 125 12 875	12 875 - 13 500	15 125	2.375	3 000	12
LS-475 SIZING CHART					
1 375 - 1 687	1 687 - 2 000	5 375	3 688	4 000	4
2 250 - 2 562	2 562 - 2 812	6 250	3 688	4 000	5
3 125 - 3 562	3 562 - 3 875	7 125	3 563	4 000	6
3 875 - 4 375	4 375 - 4 750	7 875	3 500	4 000	7
4 875 - 5 375	5 375 - 5 750	8 875	3 500	4 000	8
5 625 - 6 125	6 125 - 6 500	9 625	3 500	4 000	9
6 375 - 6 875	6 875 - 7 375	10 375	3 500	4 000	10
7 250 - 7 750	7 750 - 8 375	11 250	3 500	4 000	11
8 000 - 8 625	8 625 - 9 250	12 000	3 375	4 000	12
LS-500 SIZING CHART					
2 375 - 2 375	2 375 - 2.500	8 000	5 625	5 625	4
3 375 - 3 625	3 625 - 4 000	9 000	5 375	5 625	5
4 375 - 4 812	4 812 - 5 375	10 000	5 188	5 625	6
5 625 - 6 250	6 250 - 7 000	11 250	5 000	5 625	7
6 750 - 7 500	7 500 - 8 375	12 375	4 875	5 625	8
8 000 - 8 750	8 750 - 9 500	13 625	4 875	5 625	9
9 125 - 10 000	10 000 - 10 750	14 750	4 750	5 625	10
10 500 - 11 375	11 375 - 12 250	16 125	4 750	5 625	11
11 750 - 12 625	12 625 - 13 500	17 375	4 750	5.625	12
LS-525 SIZING CHART					
2 750 - 2 750	2 750 - 2 875	7 750	5 000	5 000	4
3 750 3 750	3 750 - 4 250	8 750	5 000	5 000	5
5 000 - 5 000	5 000 - 5 625	10 000	5 000	5 000	6
6 000 - 6 250	6 250 - 7 062	11 000	4 750	5 000	7
7 125 - 7 625	7 625 - 8 250	12 125	4 500	5 000	8
8 562 9 062	9 062 - 9 750	13 562	4 500	5 000	9
9 750 - 10 375	10 375 - 10 875	14 750	4 375	5 000	10
10 811 11 437	11 437 - 12 312	15 811	4 375	5 000	11
12 124 - 12 750	12 750 - 13 625	17 125	4 375	5 000	12
LS-575 SIZING CHART					
1 57 1 57	1 57 - 1 76	6 28	4 71	4 71	4
2 40 2 73	2 73 - 2 96	7 11	4 38	4 71	5
3 30 3 83	3 83 - 4 12	8 01	4 18	4 71	6
4 25 4 90	4 90 - 5 25	8 96	4 06	4 71	7
5 20 5 94	5 94 6 36	9 91	3 97	4 71	8
6 17 6 98	6 98 - 7 46	10 87	3 90	4 71	9
7 13 8 00	8 00 - 8 56	11 84	3 84	4 71	10
8 11 9 02	9 02 - 9 65	12 81	3 80	4 71	11
9 08 10 03	10 03 - 10 73	13 79	3 76	4 71	12

GENERAL INFORMATION



Mi ıimum Wall Thickness

Shown in the chart above, right, is the minimum wall thickness (or recommended seati g area) required to as ure a proper seal with each Link-Seal model The dimensions shown are liberal, and can be reduced if nec essary Consult factor for "absolute minim ums"

MINIMUM THICKNESS

Link-Seal Model	Minimum Wall Thickness
LS 200/LS 275	2 1/4"
LS 300/LS 315	3"
LS 325	4"
LS 400/LS-425 LS-475	5"
LS 500/LS-575 LS 525	5"
LS 600	6"

INSTALLATION NOTES

Link-Seal Model	Bolt Head Size
LS-200/LS-275	M5 slotted hex head
LS 300/LS-315 LS 325	1/2" HEX
LS-400/LS-425 LS-475	9/16" HEX
LS 500/LS-575 LS 525	3/4" HEX
LS-600	1/ 1/8" HEX

WEIGHTS

Model No	Weight for 10 Link Section
LS 200 C/LS 275	75
LS 300 C	2 00
LS 315 C	3 00
LS 325 C	5 50
LS-400 C	12 00
LS-425 C	10 00
LS-475 C	10 00
LS 500 C	27 00
LS 525 C	25 25
LS 575 C	15 00

LINK-SEAL® SIZING CHARTS FOR STANDARD DIAMETER PIPE

STEEL AND PLASTIC PIPE WITH SAME OUTSIDE DIAMETER

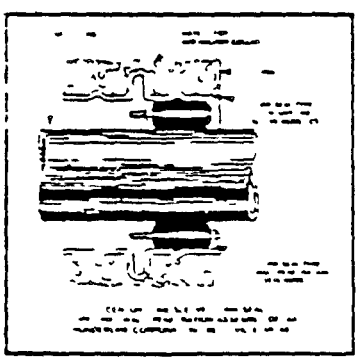
PIPE SIZE (NOMINAL)	ACTUAL OUTSIDE DIAMETER (O D)	CS MODEL PLASTIC SLEEVE			WS MODEL STEEL SLEEVE			CAST OR CORE BIT DRILLED HOLE		
		PLASTIC SLEEVE MODEL	LINK-SEAL SIZE NO **	LINKS PER SEAL	STEEL SLEEVE MODEL	LINK-SEAL SIZE NO **	LINKS PER SEAL	HOLE I D	LINK-SEAL SIZE NO **	LINKS PER SEAL
1/2	840	CS-2-*	LS-200	4	WS 2 15 S *	LS 200	4	2 000	LS 200	4
3/4	1 050	CS-3-*	LS-300	4	WS-2 1/2 20 S-*	LS-275	5	2 500	LS 275	5
1	1 315	CS-3-*	LS-300	4	WS-2 1/2 20-S	LS-200	5	3 000	LS-300	4
1-1/4	1 660	CS-3-*	LS-200	6	WS 3 21 S-*	LS 275	7	3 000	LS 275	7
1-1/2	1 900	CS-3-1/2-*	LS-275	8	WS 3 1/2 22-S-	LS-300	5	3 500	LS-300	5
2	2 375	CS-4-*	LS-300	6	WS-4 23 S-*	LS-300	6	4 000	LS-300	6
2-1/2	2 875	CS-4	LS-200	9	WS-4 23 S *	LS-200	9	4 000	LS 200	9
3	3 500	CS-5-*	LS-300	8	WS-5 25-S-*	LS-300	8	5 000	LS-300	8
3-1/2	4 000	CS-6-*	LS-325	5	WS-6 28 S-*	LS 325	5	6 000	LS 325	5
4	4 500	CS-6-*	LS-300	10	WS-6 28 S*	LS-300	10	6 000	LS-300	10
5	5 563	CS-8-*	LS-425	6	WS 8 32 S-*	LS-425	6	8 000	LS-425	6
6	6 625	CS-10-*	LS-475	10	WS-10 36 S-*	LS-475	10	10 000	LS-475	10
8	8 625	CS-12-*	LS-475	12	WS-12 37-S-*	LS-475	12	12 000	LS-475	12
10	10 750	CS-14-*	LS-400	10	WS 14 37 S *	LS-425	10	14 000	LS-400	10
12	12 750	CS-16-*	LS-400	12	WS 16 37-S-*	LS-425	12	16 000	LS-400	12
14	14 000	CS-18-*	LS-400	13	WS-18 37-S *	LS-400	13	18 000	LS 575	16
16	16 000	CS-20-*	LS-400	15	WS 20 37 S-*	LS-400	15	20 000	LS 575	18
18	18 000	CS-24-*	LS 525	16	WS 24 37 S-	LS 500	16	22 000	LS 575	20
20	20 000	CS 25-*	LS-525	18	WS 24 37-S *	LS-400	18	24 000	LS 575	22
22	22 000	CS 25-*	LS-425	20	WS 26 37 S *	LS-400	20	26 000	LS 575	24
24	24 000	N/A	—	—	WS 30 37 S	LS 500	21	28 000	LS 575	26
26	26 000	N/A	—	—	WS 30 37 S-	LS-400	23	30 000	LS 575	28
28	28 000	N/A	—	—	WS 34 37 S *	LS-500	24	32 000	LS-575	30
30	30 000	N/A	—	—	WS 36 37 S	LS 500	26	34 000	LS 575	32
32	32 000	N/A	—	—	WS 38 37 S	LS 500	27	36 000	LS 575	34
34	34 000	N/A	—	—	WS 40 37 S	LS 500	29	38 000	LS 575	36
36	36 000	N/A	—	—	WS 42 37 S	LS 500	30	40 000	LS 575	38
42	42 000	N/A	—	—	WS 48 37 S *	LS 500	36	46 000	LS 575	44
48	48 000	N/A	—	—	WS 54 37 S	LS 500	41	52 000	LS 575	50

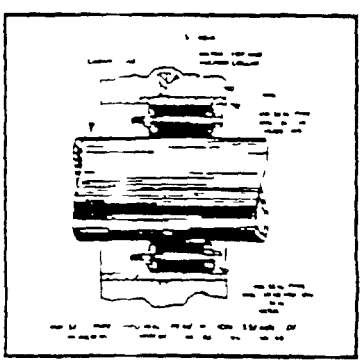
Specify sleeve length in inches
Specify model when ordering

ENGINEERING DECALS

These LINK-SEAL design decals are yours for the asking They simplify your drawings and assure proper ordering procedure

(Shown at reduced size
Actual decal measures
3 1/4 x 3 1/2")





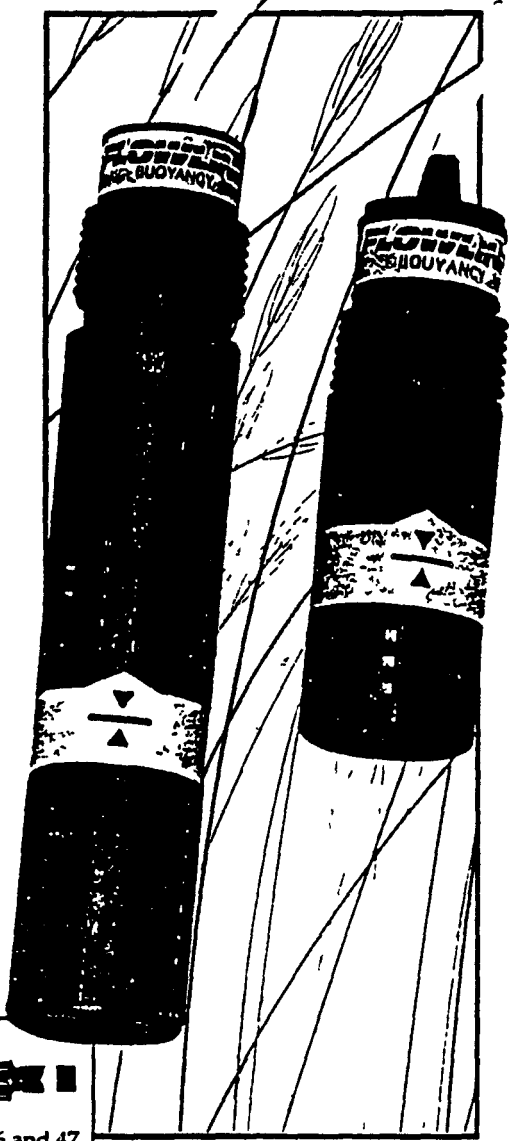
12. Product Specification Sheets for High Level Indicator and Leak Detection Indicator

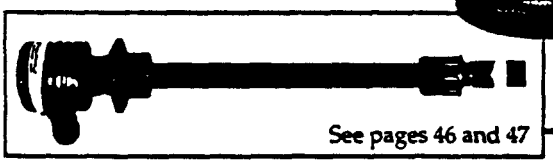
Vertical Buoyancy Sensors

- Unique filling baffle eliminates surface chatter
- Dynamically stabilized float
- Selectable normally open or normally closed states
- Mounted vertically wet or dry
- Available in quality reed switch, FET switch, 4 or 20mA, TTL and voltage output
- IP68 submersible sensor body and cable

Flowline's® Advanced Vertical Buoyancy Sensors

are technically the most advanced float available today The filling baffle causes the float to be filled below the liquid surface, thereby eliminating the effects of surface tension The self flushing design also encourages particulate matter to be purged through the baffles The sensors are conveniently available in a reed switch, FET switch, 4 or 20mA, TTL or voltage outputs





See pages 46 and 47

Specifications

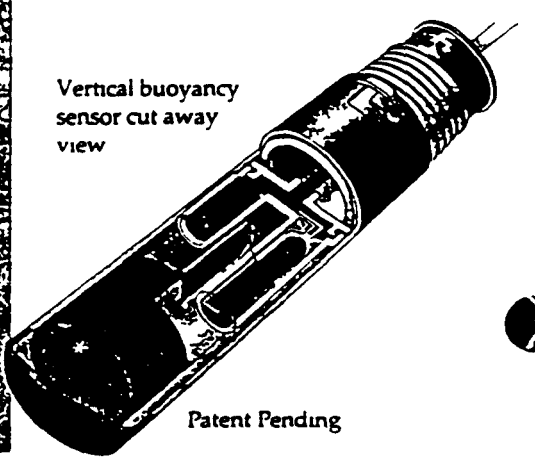
Accuracy	±2mm in water
Repeatability	±1mm in water
Dead band hysteresis	5mm in water
Wetted materials	Polypropylene (PP) or PVDF
Max temp rating	90°C (194°F)
Max pressure rating	Ambient
Specific gravity range	6 to 1 2
Extreme position	±20° from vertical
Max switching current	15 VA @ 120VAC for large, 50 VA @ 120 VAC for small switch
Signal output (reed version)	Dry switch closure, selectable, NO or NC states
Current output (FET version)	Dry 4mA Wet 20mA
FET switch voltage	0 to 36 VDC
FET switch current	100mA max (independent of supply)
FET switch mode	Selectable, NO or NC states
Enclosure rating	IP68 (NEFA 6) Submersible sensor and cable
Standard cable length	8 ft
Max cable run	Up to 500 ft
Dimensions	4 5 x 1 05 or 2 75 x 1 05 (3/4" NPT)

Ordering Information

Both reed switch, FET switch and 4 or 20mA outputs available

Part #	Description	Mat'l	Size	Price
LV10-1301	Sensor-reed switch	PP	4.5 x 3/4" NPT	$85.00
LV10-5301	Sensor-reed switch	PVDF	4.5 x 3/4" NPT	$170.00
LV10-130 -2 or 3*	Sensor-F.E.T. switch	PP	4.5 x 3/4" NPT	$125.00
LV10-530 -2 or 3*	Sensor-F.E.T. switch	PVDF	4.5 x 3/4" NPT	$250.00
LV10-1201	Sensor-reed switch	PP	2.75 x 3/4" NPT	$65.00
LV10-5201	Sensor-reed switch	PVDF	2.75 x 3/4" NPT	$130.00
LV10-120 -2 or 3*	Sensor-F.E.T. switch	PP	2.75 x 3/4" NPT	$105.00
LV10-520 -2 or 3*	Sensor-F.E.T. switch	PVDF	2.75 x 3/4" NPT	$210.00

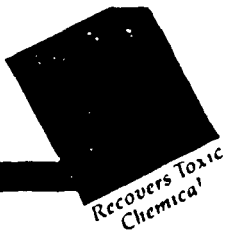
*3, for FET order -2 for N channel, -3 for P channel



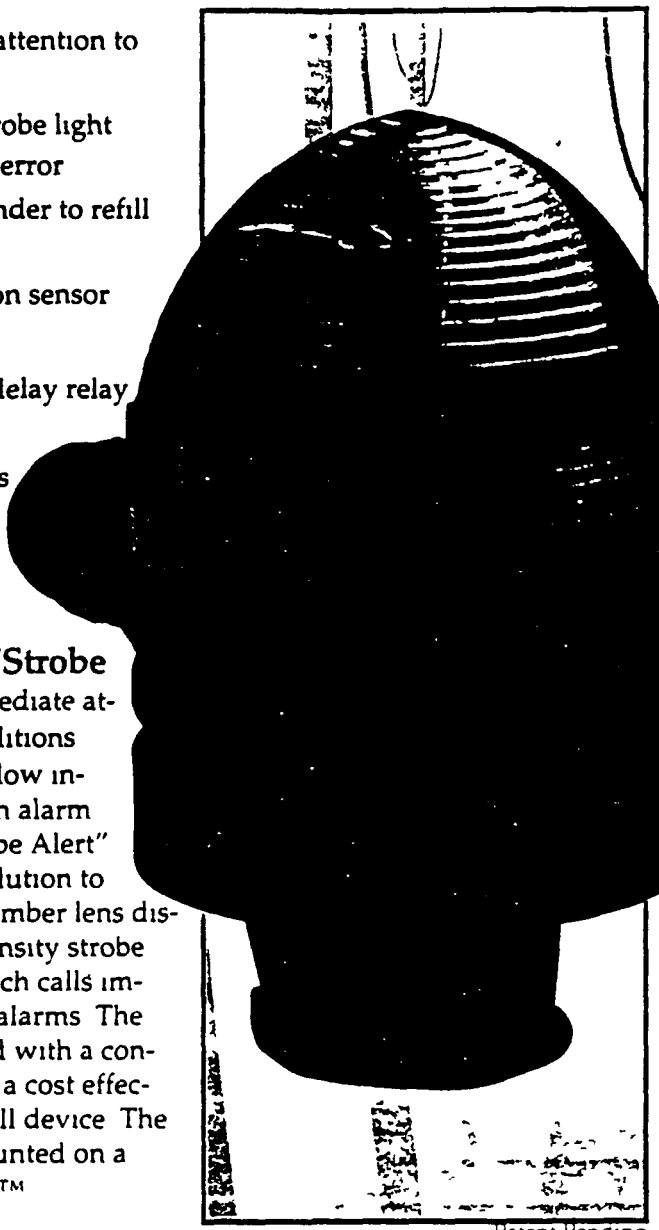
Vertical buoyancy sensor cut away view

Patent Pending

Strobe Alert™ Single Sensor Controller (DC)



- Calls immediate attention to alarm conditions
- High intensity strobe light reduces operator error
- Convenient reminder to refill tank
- Mounts directly on sensor or Smart Trak™
- Adjustable time delay relay
- Controls pumps, valves and alarms
- Swivels on base for easy conduit alignment



Patent Pending

Flowline's® DC "Strobe Alert"™ calls immediate attention to alarm conditions For operator alert to low inventory levels or high alarm conditions, the "Strobe Alert" offers an excellent solution to these problems An amber lens distributes the high intensity strobe light in a pattern which calls immediate attention to alarms The visual alert combined with a controller makes it both a cost effective and easy to install device The controller can be mounted on a sensor or Smart Trak™

Specifications

Voltage input	14 to 36 volts DC
Max current consumption	25 amps
Lighting element	High Intensity Lamp
Brightness	Greater than 50,000 CP
Relay output	Isolated and sealed single pole double throw (SPDT) relay, Form C
Switching mode	Selectable, NO or NC states
Relay switching voltage	14 to 36 VDC
Max switched current	6 amps
Time delay	Adjustable from 0 15 to 60 seconds
Max temp rating	70°C (158°F)
Sensor volt supply	Nominal 13 volts DC, 1 watt ma
Sensor trigger pt	Dry < 12mA or Wet > 12mA
Mntg connection	3/4 NPT
Conduit connection	1/2 NPT
Enclosure material	Polypropylene (PP), flame retardant (U L 94VO)
Enclosure rating	NEMA 4X (IP65)
Dimensions	2 8 x 5 5 x 3/4 NPT

For agency approved ratings contact Flowline Inc or your distributor

No cut sheet available for model LC09-1004
Differences: Voltage input: 12 to 36 VDC
relay switching voltage 12 to 36 VDC
No controller, just junction box
No continuous power draw

Ordering Information

Part #	Description	Matl	Size	Price
LC09-1002	"Strobe Alert" single sensor controller	PP	2.8 x 5.5 x 3/4" NPT	$210.00

Smart Trak™ Mounting Systems

- Adjustable in-tank mounting system
- Mounts up to four sensors
- Mixer compatible with rotational velocities of up to 1 5 fps
- Optional side mount bracket conveniently mounts Smart Trak to tank wall
- Permits different sensing technologies for additional safety
- Easy to adjust with changing processes
- Integral controller options available

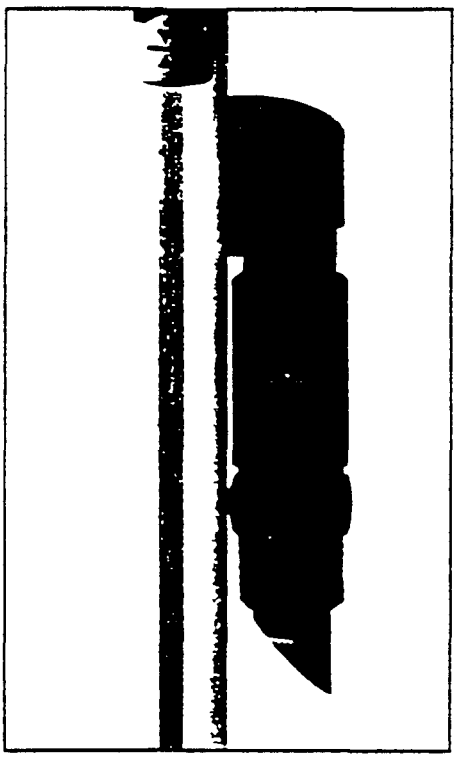
Specifications

Track length	Available in 2, 4, 6 ft
Wetted material	20% glass filled Polypropylene (PP)
Mounting threads	2" NPT tank adapter
Max temp rating	90°C (194°F)
Sensor car adjustment	Along the entire length of track
Mntg orientation	Vertical
Radial velocities	Up to 1 5 fps
Dimensions	1' square by lengths of 2, 4 and 6 ft
Side mount bracket	6 x 3 2 x 2'
Side mount bracket mntg method	Bolted or welded to side wall of tank

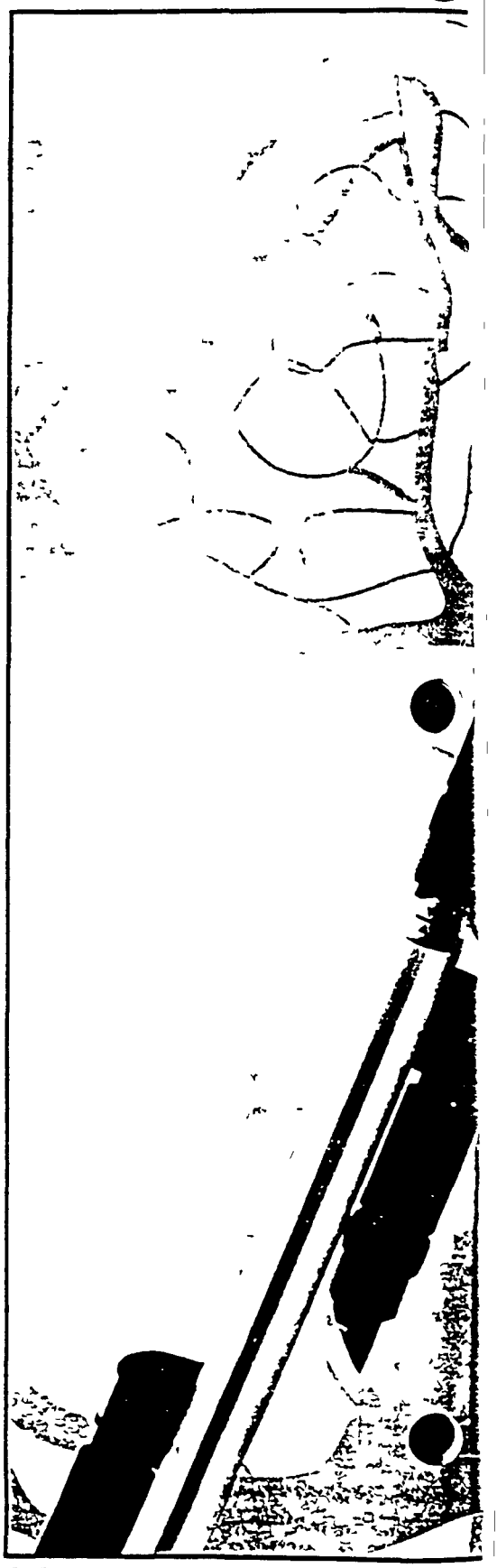
Flowline's® Smart Trak™ is an in-tank mounting system that enables the user to install and adjust up to four Flowline sensors of any technology to any depth along the entire length of the track Smart Trak is made entirely of polypropylene and is available in two, four or six foot lengths Lengths of up to 20 feet can be special ordered

Select Smart Trak for mixing applications with radial velocities up to 1 5 fps Smart Trak mounts vertically through the top of the tank with a standard 2" NPT rotational tank adapter Each Smart Trak kit includes a 2' NPT fitting assembly, a two, four or six foot Smart Trak section, and one sensor car Additional sensor cars can be purchased separately

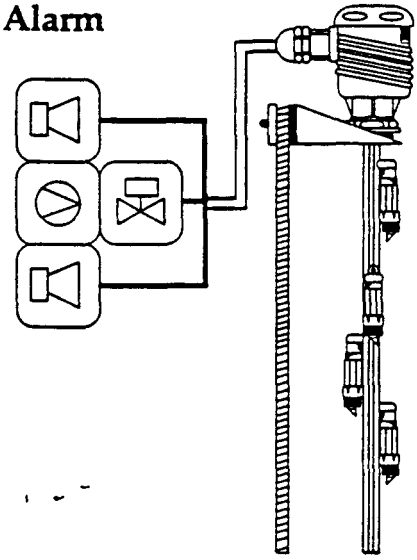
Smart Trak Sensor Car



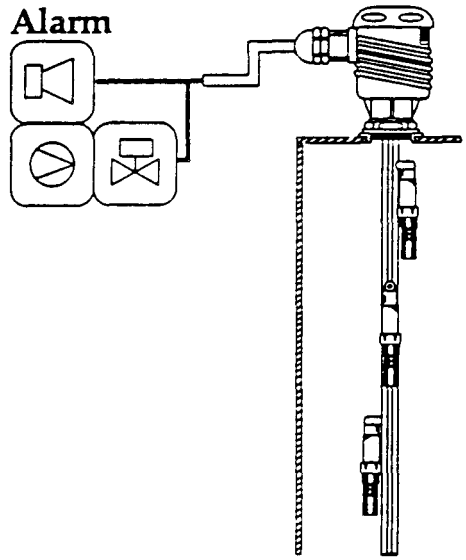
Side Mount Bracket



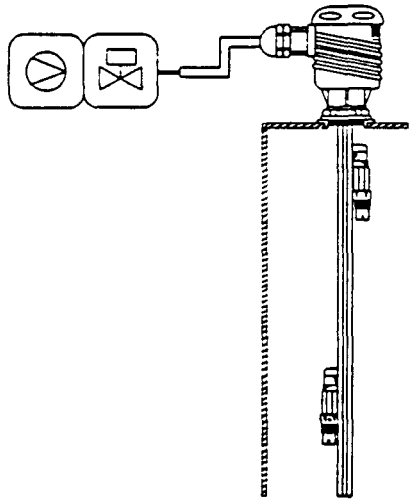
Automatic Fill or Empty with High and Low Level Alarm



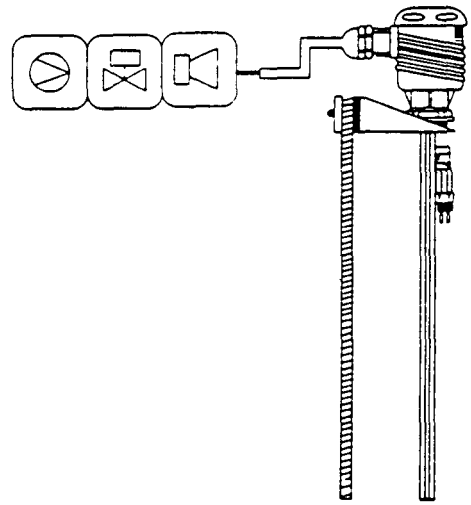
Automatic Fill or Empty with High or Low Level Alarm



Automatic Fill or Empty



High or Low Level Switch



Ordering Information

SmartTrak™ kits include one sensor, cap

Part #	Description	Material	Size	Price
ALM10-120T	SmartTrak Kit	PP	2"x1" sq	$55.00
ALM10-Y40T	SmartTrak Kit	PP	4"x1" sq	$85.00
ALM10-150T	SmartTrak Kit	PP	6"x1" sq	$120.00
ALM30-100T	Sensor and cap	PP	2"	$20.00
ALM50-100T	Side mount tube style	PP	3"x3"x2"	$80.00

Lengths of up to 20 feet can be special ordered.

13. Product Specification Sheets for Flow Sensor and Flow Transmitter

SIGNET 2535 Rotor-X Low Flow Sensor

Description

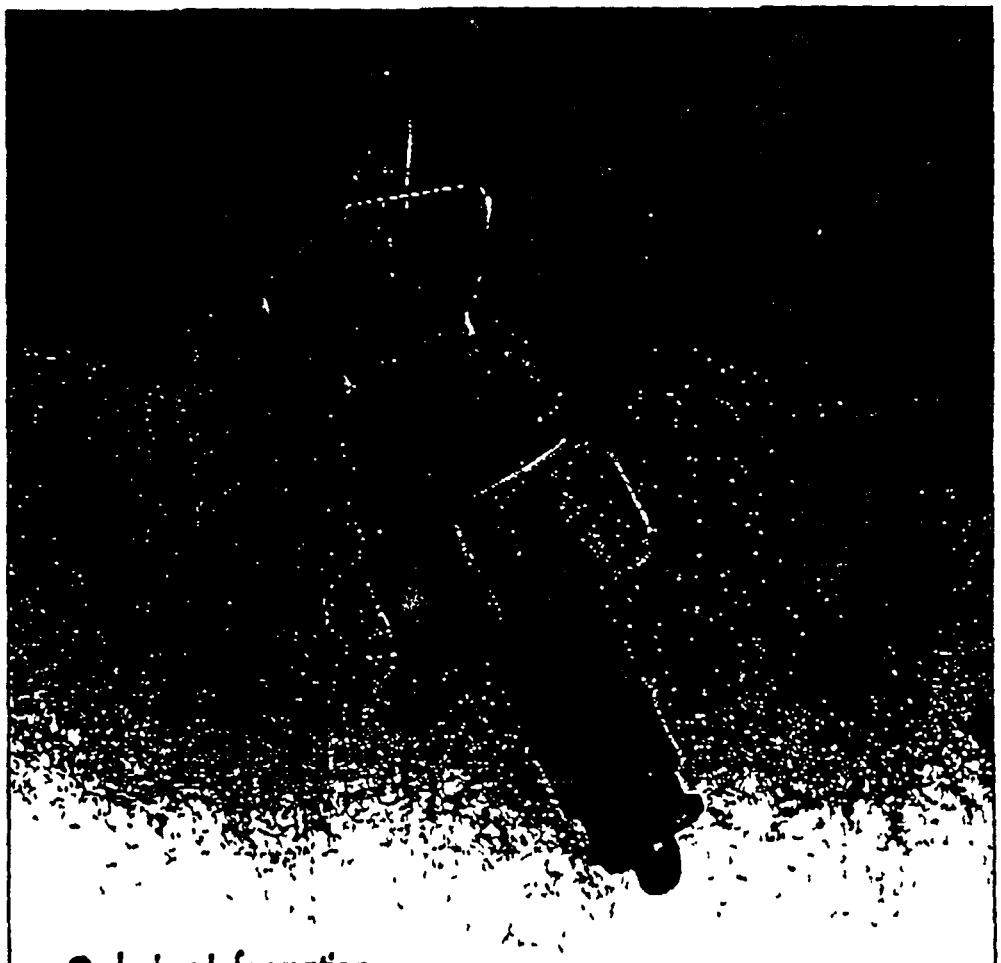
The SIGNET 2535 Rotor-X Low Flow Sensor is ideal for measuring flow in piping systems with extremely low velocities. Utilizing insertion paddlewheel technology, the 2535 is easy to install and maintain.

The 2535 combines Hall Effect sensing with the advantages of insertion paddlewheel technology. This technology allows the 2535 to be used in low velocity applications.

Key Specifications

- Flow Range: 0.3 to 20 ft/s, 0.1 to 6 m/s
- Linearity: ±1% of full range
- Repeatability: ±0.5% of full range
- Supply Voltage: 5 to 24 VDC
- Temperature/Pressure: See chart on page 65
- Output: Open collector, sinking
- Wetted material:
  Housing - Polypropylene or PVDF
  Rotor - PVDF
  Shaft - Titanium (options available)
  O-Ring - Viton

- **Flow rates as low as 0.3 ft/s**
- **Corrosion-resistant plastic**
- **Extended temperature range**
- **Companion fittings for various piping systems**



Ordering Information

Part No.	Housing Material	Pipe Size (in.)
3-2535-P0	Polypropylene	0.5 to 4
3-2535-P1	Polypropylene	5 to 8
3-2535-P2	Polypropylene	10 - up
3-2535-V0	PVDF	0.5 to 4
3-2535-V1	PVDF	5 to 8
3-2535-V2	PVDF	10 - up

NOW WITH TOTALIZER

SIGNET 8510/8511 Compak Flow Transmitters

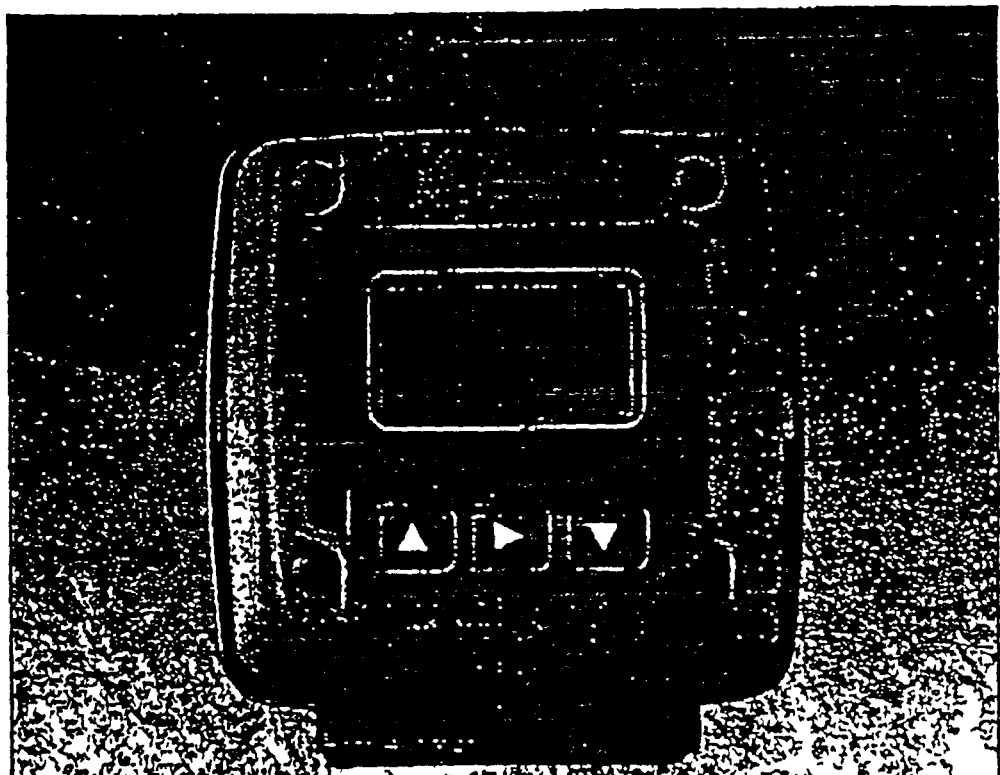
Description

The SIGNET 8510/8511 Compak Flow Transmitters provide an isolated 4 to 20 mA signal from a range of Signet flow sensors. Sealed NEMA 4X electronics eliminate the need for potentiometers or test equipment. External keys and display allow setup in minutes. The 8510 can be spanned for any flow range or engineering unit. Universal mounting hardware enables installation in virtually any application.

Specifications

- Loop Power. 10 to 30 VDC
  8510 two-wire
  8511 four-wire 500 VDC loop isolation
- Display Range 0.01 to 9999
  Totalizers 0 to 99999999
- Loop Accuracy ±50 µA
- Input Frequency Range.
  8510 5 to 500 Hz
  8511: 5 to 10 Khz

- **Isolated adjustable 4 to 20 mA output**
- **Flow rate and totalizer display**
- **Universal installation for pipe or surface mounting**
- **Push-button calibration**
- **User-selectable range and units**
- **Frequency output for remote instruments**



Ordering Information

	Part No.	Description
	3-8510	8510 Flow Transmitter (Two - wire)
	3-8511	8511 Flow Transmitter (Four - wire)
Accessories:	3-8010	Universal mounting kit (NPT ports)
	3-8010-D	Universal mounting kit (DIN ports)
	3-8011	Integral mounting kit (NPT ports)
	3-8011-D	Integral mounting kit (DIN ports)
	3-8510-P0	Integral sensor, 0.5 to 4 in. pipe - polypro
	3-8510-P1	Integral sensor, 5 to 8 in. pipe - polypro
	3-8510-V0	Integral sensor, 0.5 to 4 in. pipe - PVDF
	3-8511-P0	Integral sensor, 0.5 to 4 in. pipe - polypro (Low Flow)
	3-8511-P1	Integral sensor, 5 to 8 in. pipe - polypro (Low Flow)
	3-8511-V0	Integral sensor, 0.5 to 4 in. pipe - PVDF (Low Flow)

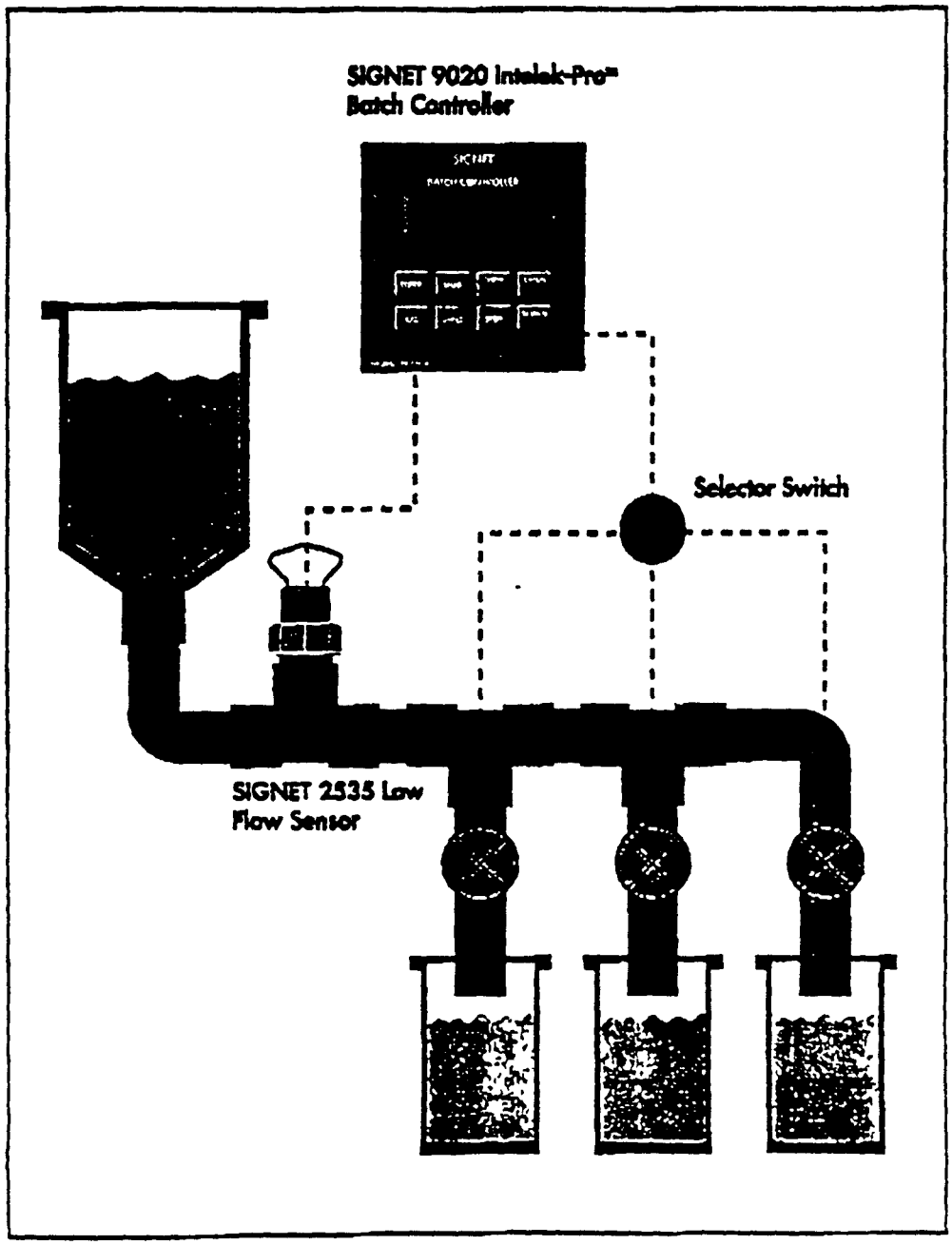
2535 Gravity Feed Application

Using gravity to dispense liquid is a common practice in industry to save energy and pumping costs In gravity feed applications, flow velocities are low and continue to drop depending on the level of the dispensing tank.

The SIGNET 2535 Rotor-X Low Flow Sensor is an ideal solution for these applications since it can measure flow rates as low as 0.3 ft/s

The following diagram illustrates the use of a gravity feed system in a textile plant

The 2535 is used with a SIGNET 9020 Intelek-Pro Batch Controller to complete a batching system. A selector switch is used to choose the appropriate tank that needs to be filled



SIGNET 8510/8511 Compak Flow Configuration

NEW

Standard Installation

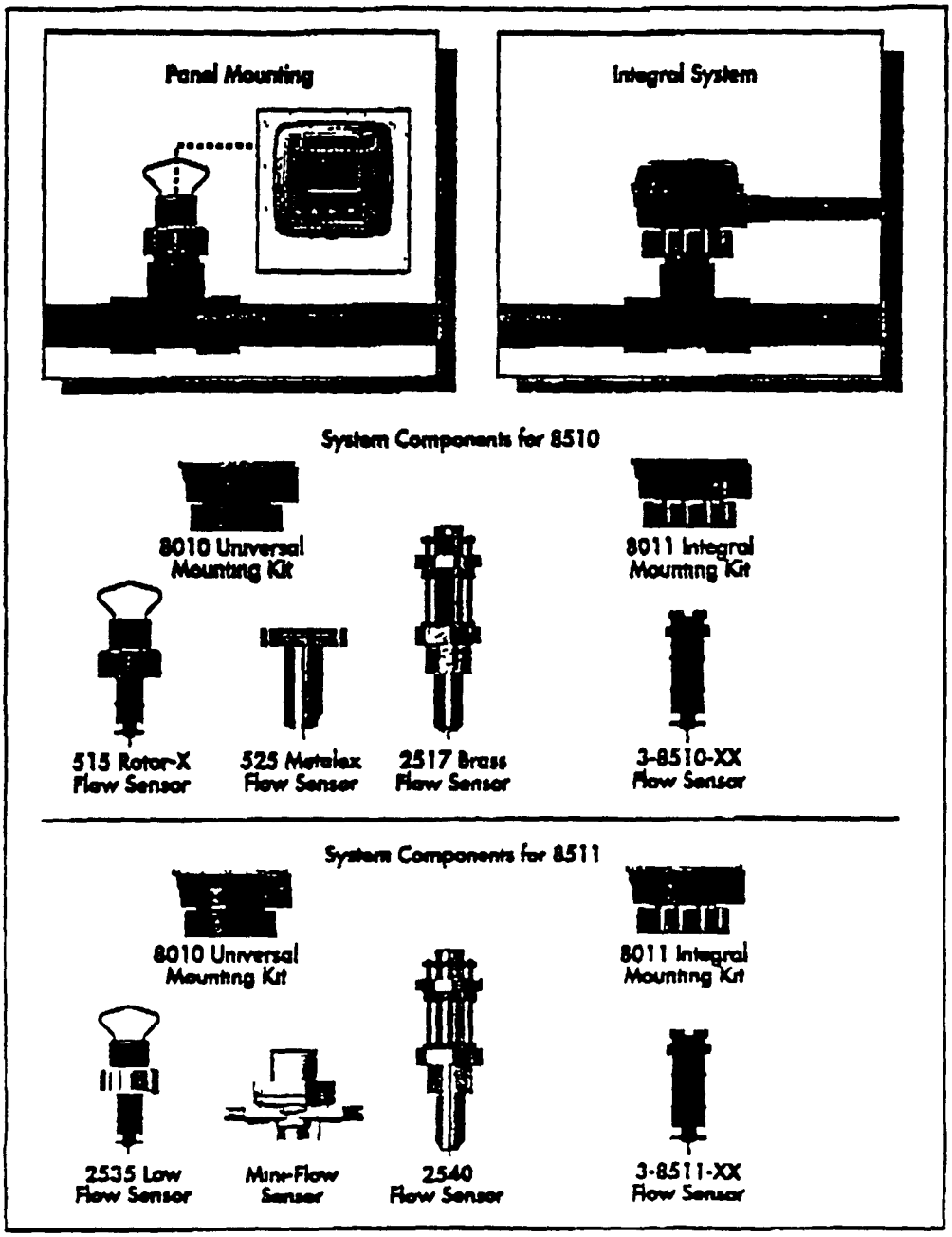
- Choose from a range of Signet flow sensors
- Use the SIGNET 8510 Compak Flow Transmitter to mount directly on a panel (non-powered sensors)
  or
  Use the SIGNET 8511 Compak Flow Transmitter to mount directly on a panel (powered sensors)

Pipe or Surface Installation

- Add the SIGNET 8010 Universal Mounting Kit

Integral System

- Use the SIGNET 8510 or 8511 Compak Flow Transmitter
- Select a SIGNET 3-8510-XX sensor for the 8510 Transmitter, or a 3-8511-XX sensor for the 8511 Transmitter
- Select the SIGNET 8011 Integral Mounting Kit



Flow Installation Guidelines

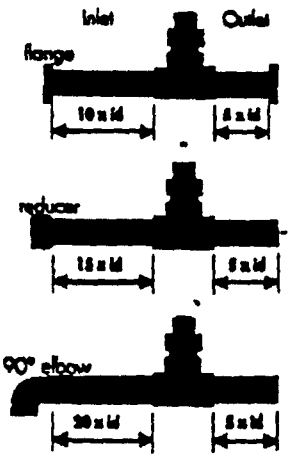


Figure 1: Flow sensors generally depend upon a "fully developed turbulent flow profile" for maximum linearity and accuracy. To achieve this, the sensor must be located in a straight run of pipe upstream and downstream of the sensor

Major obstructions such as pumps or throttled valves will require longer straight runs

Figure 2: In horizontal pipe runs with no air pockets or sediment present, mount the sensor/fitting in the 12 o'clock or 6 o'clock position If sediment or air pockets are present, tilt the sensor/fitting at a maximum angle of 45° to overcome these obstacles

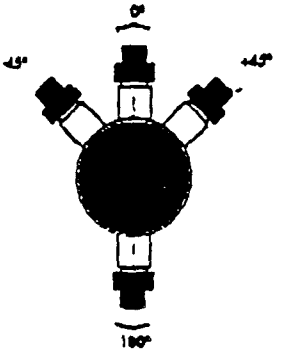
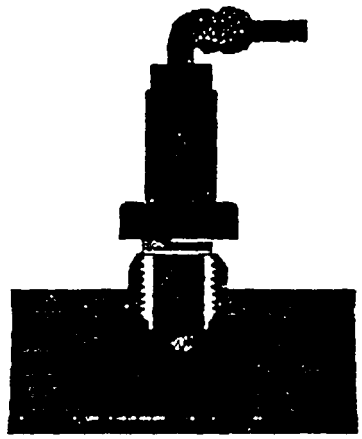


Figure 3: The most common flow profile found in industrial applications are fully developed turbulent flow (required for Signet sensors) The second type, disturbed turbulent flow, is less stable and occurs when the flow is interrupted by a valve, elbow, or other obstruction To achieve a developed turbulent flow, refer to the steps in Figure 1 The third type, laminar flow, occurs with highly viscous fluids, or fluids travelling at very low velocities This flow condition is measured with a Reynolds number Typically, flow conditions with a Reynolds number lower than 2,000 are considered laminar For a developed turbulent flow acceptable for Signet sensors, this number should be above 4,500.

pH and Conductivity Sensor Installation Guidelines

Figure 1: For proper sampling and increased life, the sensor should be placed as far as possible from point of reagent addition, and close to the exit of the tank in submersible applications Flow rate past the electrode should be less than 4 ft/s for bulb and 5 ft/s for flat surface configurations

Signet's unique connection technology makes it easy to maintain a clean, dry contact between the probe and pre-amplifier. Contact surfaces should be protected from excessive exposure to dirt or spray during installation and maintenance. Signet pre-amplification allows for pH signal transmission up to 400 ft Keep electrode clean and well maintained for a longer life



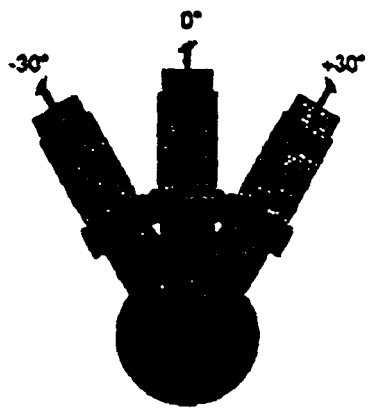
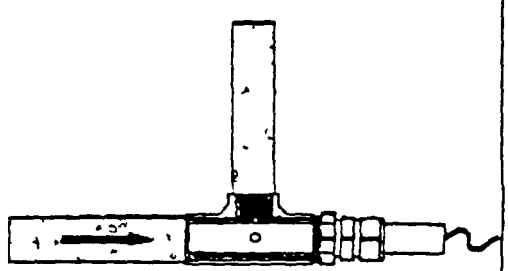


Figure 2: In order to maintain proper flow of electrolyte through the reference junction, and to prevent air from affecting the measuring element, pH electrodes should be mounted vertically ±30° Keep the electrode wet at all times Storage is best in a KCL solution

Figure 3: For a standard threaded sensor, mounting with flow into the sensor is recommended A four o'clock installation position is ideal when the sensor is used with Signet fittings The electrode should be mounted to prevent air entrapment in the sensor In aerated tanks, a baffle may be needed Coating of the electrodes will cause erroneous readings, so avoid oils from coming in contact with the electrode Conductivity signal transmission to 100 ft is acceptable



Min/Max GPM Values For SIGNET Insertion Sensors

The values provided in the chart below are for product comparison in schedule 40 metal pipe

The minimum/maximum gpm values will differ depending on pipe size, schedule and pipe material.

Pipe Size (in.)	2535 3-8511-XX	2550	2540	515 3-8510-XX	525
Min FPS **Max FPS**	**0.3** **20**	**0.3** **20**	**0.3** **20**	**1** **20**	**1.6** **20**
0.5	0.3 19	- -	- -	1 19	1.6 19
0.75	0.5 34	- -	- -	1.7 34	2.7 34
1	0.8 54	- -	- -	2.7 54	4.4 54
1.25	1.4 94	- -	- -	4.7 94	7.4 94
1.5	1.9 127	- -	1.9 127	6.4 127	10.1 127
2	3.2 210	3.2 210	3.2 210	10.6 210	16.8 210
2.5	4.5 300	4.5 300	4.5 300	15 300	24 300
3	7 461	7 461	7 461	24 461	37 461
4	12 794	12 794	12 794	40 794	63 794
5	19 1247	19 1247	19 1247	63 1247	100 1247
6	27 1801	27 1801	27 1801	91 1801	144 1801
8	47 3119	47 3119	47 3119	156 3119	250 3119
10	74 4915	74 4915	74 4915	246 4915	393 4915
12	105 6977	105 6977	105 6977	349 6977	559 6977
14	127 8432	127 8432	127 8432	422 8432	-
16	166 11015	166 11015	166 11015	551 11015	
18	210 13942	210 13942	210 13942	698 13942	- -

Recommended Scale Ranges (In gallons per minute)

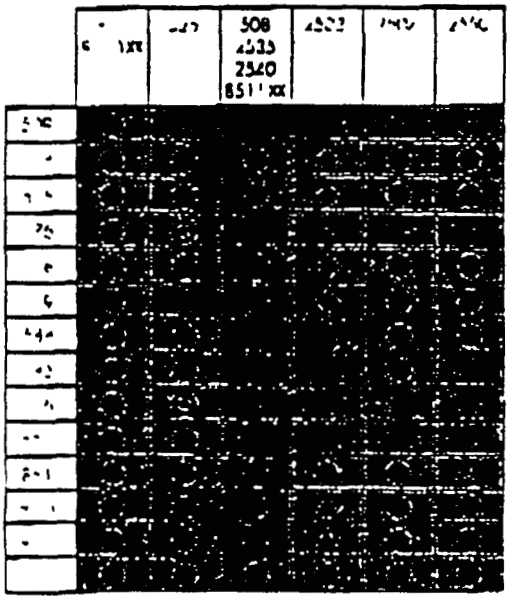
Recommended full scale calibration ranges for individual pipe size installations are shown in the chart below. Average flow rate should be approximately 50% of the scale.

Although systems are normally calibrated in gallons per minute (GPM), virtually any volumetric unit is available for use in establishing system calibration.

For use with SIGNET analog indicators and the SIGNET 515, 525, and 2535.
*Min not available on 509 indicator

Pipe Size (In.)	Std.	Opt.	*Min.	Total
0.50	0-18	0-12	0-6	X 1
0.75	0-30	0-18	0-12	X 1
1	0-50	0-30	0-18	X 1
1.25	0-80	0-50	0-30	X 10
1.50	0-120	0-80	0-50	X 10
4	0-180	0-120	0-80	X 10
2.50	0-300	0-180	0-120	X 10
3	0-500	0-300	0-180	X 10
4	0-800	0-500	0-300	X 100
5	0-1200	0-600	0-500	X 100
6	0-1800	0-1200	0-800	X 100
8	0-3000	0-1800	0-1200	X 100
10	0-5000	0-3000	0-1500	X 100
12	0-8000	0-5000	0-3000	X 1000
14	0-12000	0-6000	0-5000	X 1000
16	0-12000	0-8000	0-6000	X 1000
18	0-18000	0-12000	0-8000	X 10000

Sensor/Indicator Compatibility Matrix



14. Design Calculations for Solar Panel and Battery

REMOTE Power INC.

12301 North Grant Street, # 230
Denver, Colorado 80241-3130
Office (303) 452-9383
FAX (303) 452-9519

Solar Electric Power Systems

TO: John Jankousky
The S.M. Stoller Corporation

FROM: John Phillips

RE: Solar Electric Generator for the Rocky Flats Project

DATE: August 24, 1995

FAX: 303-443-1408

My recommendation for the language in your document under "2.3 Power Supply" is as follows:

2.3.1 Power supply shall be shared for the flow meter, the high level indicator, and the leak detection indicator. It shall consist of a solar electric generator Model Number ST60-2G27-24V, with voltage regulation, engineered and manufactured by Remote Power Inc. The solar electric generator is to be installed on a two-inch Schedule 40 steel pipe (at least ten feet long, secured 30 inches into the ground with concrete). The solar electric generator's battery enclosure, the two Flowline LC06-1001 junction boxes, and the flow transmitter are to be connected with 1/2 inch rigid galvanized steel conduit through which the wiring connections are to be made. The electrical connection between the terminal strip in the solar electric generator, the two Flowline LC06-1001 junction boxes, and the flow transmitter are to be made with THHN 14 guage wire.

The quote for this system is as follows.

Generator model: ST60-2G27-24V, with voltage regulation
Site location: Rocky Flats, near Denver, Colorado
Power requirements: 24 volts nominal, for
(a) flow transmitter operating at .120 miliamps, continuous
(b) high level indicator operating at .250 miliamps for up to 23 hours in any one day, maximum two days a week
(c) leak detection indicator operating at .250 miliamps for up to 23 hours in any one day, maximum one day a week
No sun operation: 11.5 days

Major components:
(2) Solarex MSX-30 solar electric panels
(2) Sealed gel batteries, Group 27 size
(1) 12 volt, 8 amp charge regulator, with temperature compensation
(1) Enclosure for the batteries, insulated, with charge regulator installed and wired
(1) Mounting hardware for the solar electric panel
- Miscellaneous wiring and mounting hardware
- Installation instructions

NOTE: this quote does not include the pole, site work, or installation

PRICE: $1,972.17 FOB our dock

REMOTE Power INC

John Jankousky
The S.M. Stoller Corporation
page 2

All generators we manufacture for commercial uses contain only the highest quality, field proven components specifically matched to maximize return on capital investment. In addition to the warranties provided by the manufacturers of individual components, Remote Power warranties its generators to perform as specified for one full year (a complete weather cycle).

If there is anything else we can do for you, let me know. Either I or our engineers can answer any questions either you or your customer may have.

SOLAR ELECTRIC GENERATOR SYSTEM SIZING AND PERFORMANCE REPORT

Remote Power Inc. 12301 N. Grant St. #230, Denver CO 80241 800-284-6978

Solar Electric Generator for The S.M. Stoller Corporation
Rocky Flats Project
System Design - August 24, 1995

adjusted to account for voltage regulator inefficiencies

Load	Description	Load Profile	Amperes	Average Hours/day	Weekly Profile Days of Week On
1	flow transmitte	24 hours	0.150	24.00	1 2 3 4 5 6 7
2	high strobe	24 hours	0.313	23.00	1 - - 4 - - -
3	leak strobe	24 hours	0.313	23.00	1 - - - - - -

Nominal PV System Voltage: 24 Array mounting = Fixed tilt Array
Power system type: DC System with battery , NO maximum power tracker

Solar data and temperature location: DENVER, COLORADO, U.S.A.
Latitude= N 39:45 Longitude= W104:48 Elevation= 1625 (M)
Azimuth = 0 Albedo = 20%

PV ARRAY DESCRIPTION (ratings at 25½C)

Modules: Solarex, MSX-30 Total Modules = 2
Series = 2 Parallel = 1 Power = 60 Peak Watts
Max. power voltage= 34.2 Max. power current = 1.8
Open circuit voltage= 42.2 Short circuit current = 1.9
Mismatch loss(%)= 3 Dirt loss(%)= 5 Wiring loss(%)= 2

BATTERY SUBSYSTEM (ratings at 25½C)

Battery: MK BATTERY, 27 GEL Amp-hr/ea = 98 Volts/ea = 12
Series = 2 Parallel = 1 Total= 2 Max. month daily DOD = 12.52%
Total Amp-hrs.= 98 Battery Charge Efficiency = 95% Weight= 57 Kg
Equivalent to 11.73 days at highest monthly load to 80% DOD

ESTIMATED PERFORMANCE

Month	Global kWh/M²	Tilt	@Tilt kWh/M²	Mean °F	Gross A-hr/d	Array Net A-hr/day	Load A-hr/day	Deficit A-hr/d	Array/Load SOC	Array/Load Ratio
Jan	2.63	60	5.38	28.9	9.42	9.06	6.69		87-100	1.36
Feb	3.41	60	5.38	30.9	9.42	9.06	6.69		87-100	1.35
Mar	5.07	60	6.67	38.5	11.68	11.28	6.69		88-100	1.69
Apr	6.02	60	6.03	48.7	10.55	10.17	6.69		88-100	1.52
May	6.96	60	5.66	57.2	9.91	9.51	6.69		88-100	1.42
Jun	7.39	60	5.41	64.8	9.46	9.06	6.69		88-100	1.36
Jul	7.33	60	5.58	72.9	9.77	9.34	6.69		88-100	1.40
Aug	6.35	60	5.77	70.2	10.10	9.67	6.69		88-100	1.45
Sep	5.60	60	6.54	62.2	11.45	11.04	6.69		88-100	1.65
Oct	4.22	60	6.45	49.1	11.29	10.92	6.69		88-100	1.63
Nov	2.78	60	5.10	38.3	8.93	8.59	6.69		87-100	1.28
Dec	2.35	60	5.08	30.7	8.90	8.55	6.69		87-100	1.28

Lowest array to load Amp-hr/day ratio is 1.28

(Array Gross: 25½C, no losses. Array Net: All losses and temperature effects.)
Filed as: STOLLER.668 Calculated by PVCAD

183

15. Wind Loadings and Structural Calculations for 65-Gallon Drum Holder and Solar Panel

SEEP TREATMENT @ ROCKY FLATS

STRUCTURAL ELEMENTS DESIGN CALCULATIONS

by
John H. Allen P.E.
9/18/95

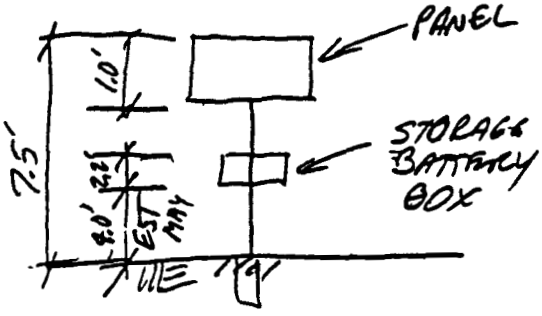
DESIGN DATA: LOADS: DESIGN WIND : 109 MPH
SEISMIC - ZONE I, CAT. III

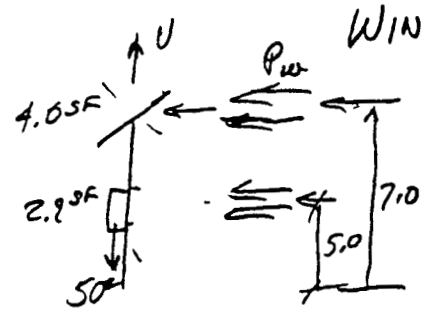
CODE: UBC '91

MATERIALS : STEEL A-36
CONCRETE : f'_c = 3000 psi @ 28 days

SOLAR PANEL SUPPORT — WIND SPEED = 109 MPH

WIND CONTROLS!





$P_w = q_s C_g C_a$
$= 31 \cdot 1.4 \cdot 1.39$
$= 60\ PSF$

Check Pole Size

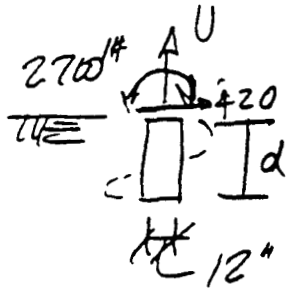
$M = 7.0 \times 4 \times 60 + 5.0 * 2.9 \times 60 + .5' \times 50^{\#}$
$= 1740^{1\#} + 900^{1\#} + 25^{1\#} = 2665^{\#}$

Try 2"ϕ Schedule 40 (STD WGT)

$M = .326^{in^3} \times 21^{KSI} = 571^{1\#}$ NG

$\min S = \frac{2665 \times 12}{21000} = 1.52\ in^3$ USE 3"ϕ

Check Footing Size: USE Nominal Soil LATERAL BEARING = 400psf

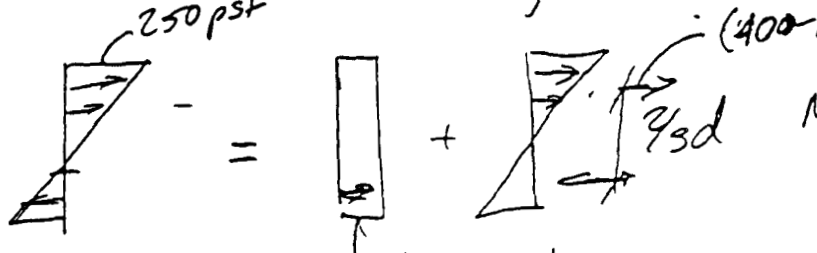


$U = 4.0 \times 1.8 \times 60 = 430^{\#} \uparrow$

$V = 2U = (.78^{1.03} \times 1.45 + 100^{3.14} \times 3.14)\, d$ ↑ UPWARD SOIL FRICTION

$\min d = \frac{2 \times 430}{427} = 2.1'$

try 2.5'



$M = 290 \times \frac{2}{3} \times 2.5$
$= 480^{1\#}$ N/

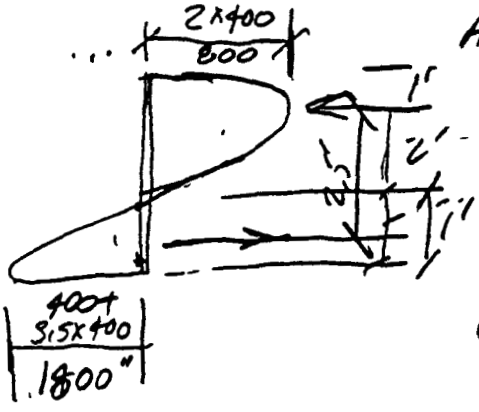
$H/bd = \frac{420}{25} = 17.0$

try 1.5x4' pier

$$M_R = \left(400 - \frac{420}{6}\right) \times \frac{d^2}{3} = (330) \times \frac{4^2}{3} = 1760$$

CAN ALLOW GREATER BEARING @ DEEPER DEPTHS

ASSUME PRESSURE DISTRIB AS SHOWN



$F_{HR} = \frac{2}{3} \times 800 \times 3' = 1600^{\#}$

$M_R = 2.5' (1600 - 420) = 2950^{1\#}$

> 2665 OK

Check bottom pressure

$F_{BR} = \frac{2}{3} \times 1600 \times 1' = 1200^{\#}$

$= 1600^{\#} - 420 = 1180^{\#}$ OK

NOTE - these pressures are for 1' ϕ pier

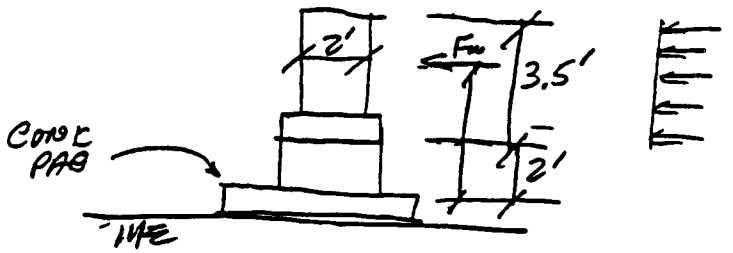
USE: 1'ϕ x 4'-0" PIER

MAX CLAMP FORCE - 250# < 800# MFGR RATING

OK

ALLEN CONSULTING ENGINEERS SUBJECT CONTAINMENT SHEET NO. 3 OF ___
DESIGN JHA DATE 9/15/95 CHECK ___ DATE ___ JOB NO. 515

TREATMENT CHEMICAL SUPPORT

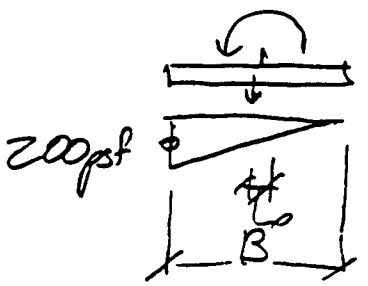


$P_w = 60$ psf
(neglect reduction for circular shp.

$F_w = 60 \times 2 \times 3.5 = 420^{\#}$

$M = 420 \times 3.75' = 1575^{\#}$

FIND CONCRETE PAD SIZE - FULL CONTACT UN REINFORCED 8" THICK PAD (100 psf)



$B = e/6$ $\quad W = 100\,B^2$

$e = 6B$ (1) $\quad e = \frac{M}{W}$ (2)

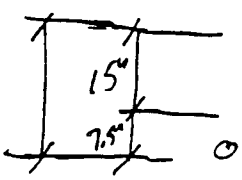
combining $6B = \frac{M}{100B^2}$

$B^3 = \frac{M}{600} = \frac{1575}{600} = 2.65'$

$B = 1.38'$

USE: 4' ⌀

SIZE SUPPORT LEGS - ASSUME 3 @ 30" circle
est TANK & CONTENTS ~ 600#



$C = 2T = \frac{1575 \times 12"}{22.5} + \frac{600^{\#}}{3}$

$= 840 + 200 = 1040^{\#}$

for Single L's MAX $b/t < 10.8$

try 2x2x1/4 ($b/t = 8$) $r_{zz} = .391$ $\quad \frac{Kl}{r} = \frac{1.2 \times 24}{.391} = 74$

$C_c = 126$

$f_a = \frac{1040}{1.38} = 1100^{\#} \ll F_a$ OK $\quad Kl/r/C_c = .59 \rightarrow F_a = .444 F_y$

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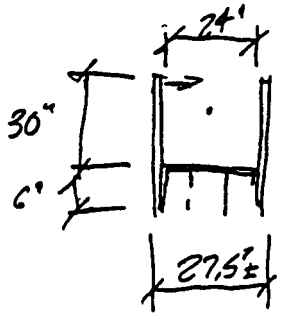
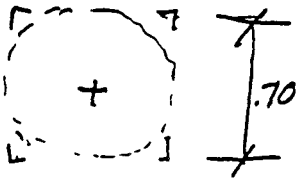
FOUR LEG SUPPORT



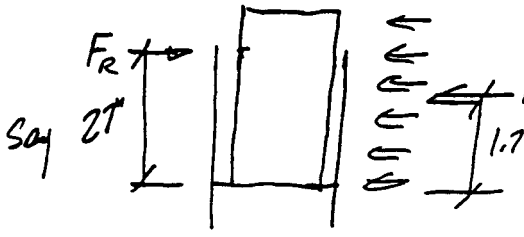


FORCE/ANGLE, $P = \frac{1575 \times 12}{2 \times 19.4"} + \frac{600}{4} = 1124^{\#}$

$P_a > .938 \times 16000 = 15000^{\#}$ OK

Check WIND ON EMPTY BARREL

CARRY FULL LOAD ON EACH LEG EQUALLY



$F_R = \frac{420 \times 21}{27} = 327$

$M = F_R \times 27 = 8800^{\#}$

$f_b = \frac{8800}{.247} = 17800 \text{ psi} < 22^{ksi}$ OK

USE 2" x 1/8" STRAP w/hinge & bolt for barrel support

bolt force $= \frac{420^{\#}}{2} = 210^{\#}$

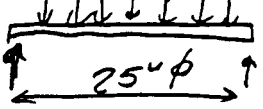
Min $\phi = A_b = \frac{210}{.85 \times 22000} = .01 \text{ in}^2$

LOET ANY SIZE

USE 3/8"

Bottom R thickness

$p = \frac{60 \times 3.5}{144} = 1.5 \text{ psi}$

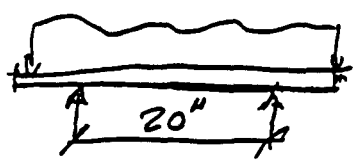


$M = \frac{Pr^2(3+\nu)}{16} = \frac{1.5 \times 25^2 (3.3)}{16}$

$= 194^{11\#}/_{11}$

$t = \sqrt{\frac{6M}{22^{ksi}}} = .22"$ USE 1/4"

BOTTOM & EDGE & SUPPORT



$w = \frac{W}{C} = \frac{600^{\#}}{\pi \times 24"} = 8.0^{\#}/"$

use $M = \frac{1}{8} w l^2 = \frac{8 \times 20^2}{8} = 400^{"\#}$

PERIMETER RIB:

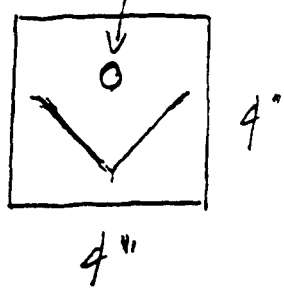
$S = \frac{400 \times 12}{22000} = .22 in^3 = \frac{bh^2}{6}$

for $b = \frac{1}{4}"$ $\quad h = \sqrt{\frac{6 \times .22}{.25}} = 2.3"$

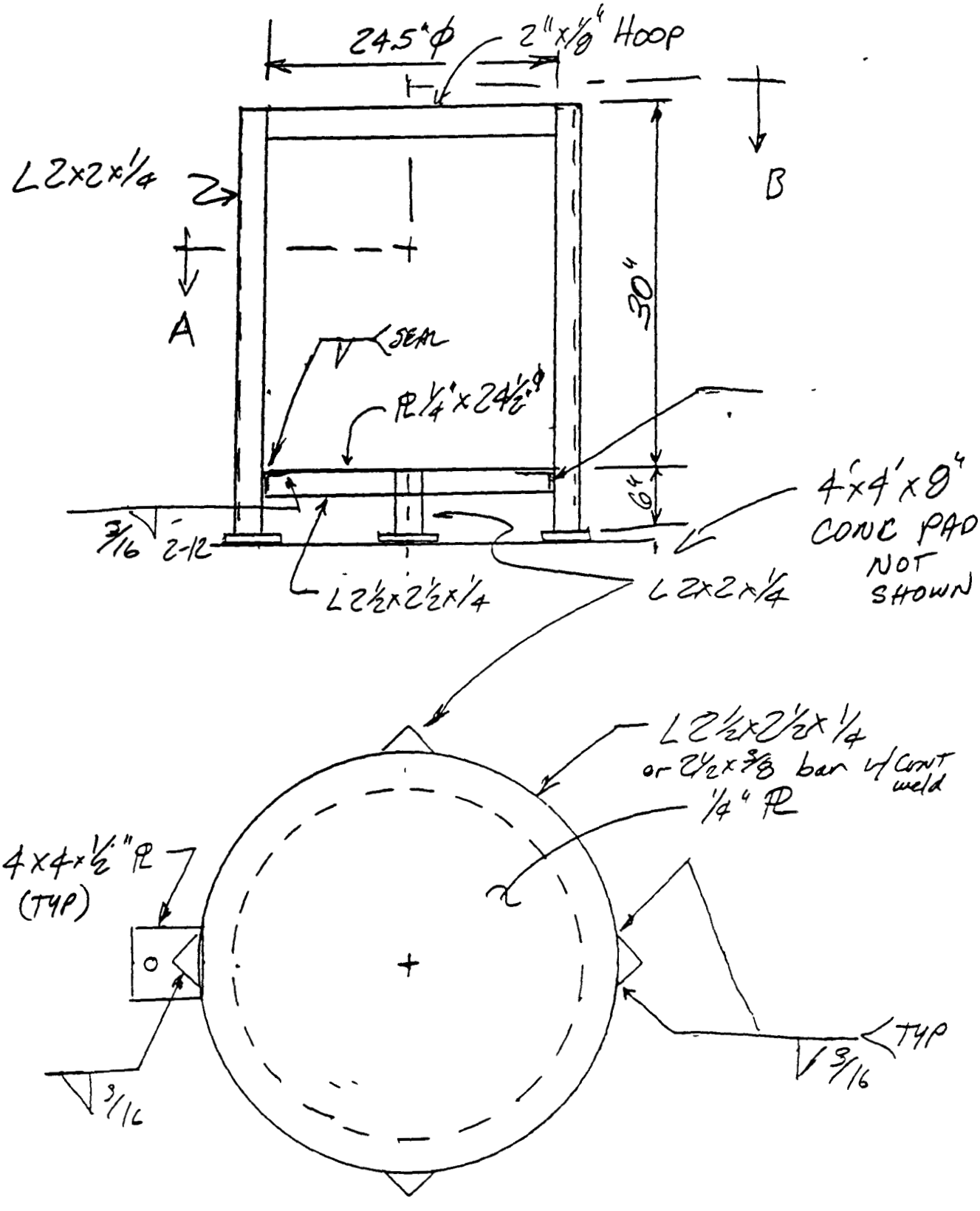
USE L $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$

or L $2 \times 2 \times \frac{3}{8}$ (obviously)

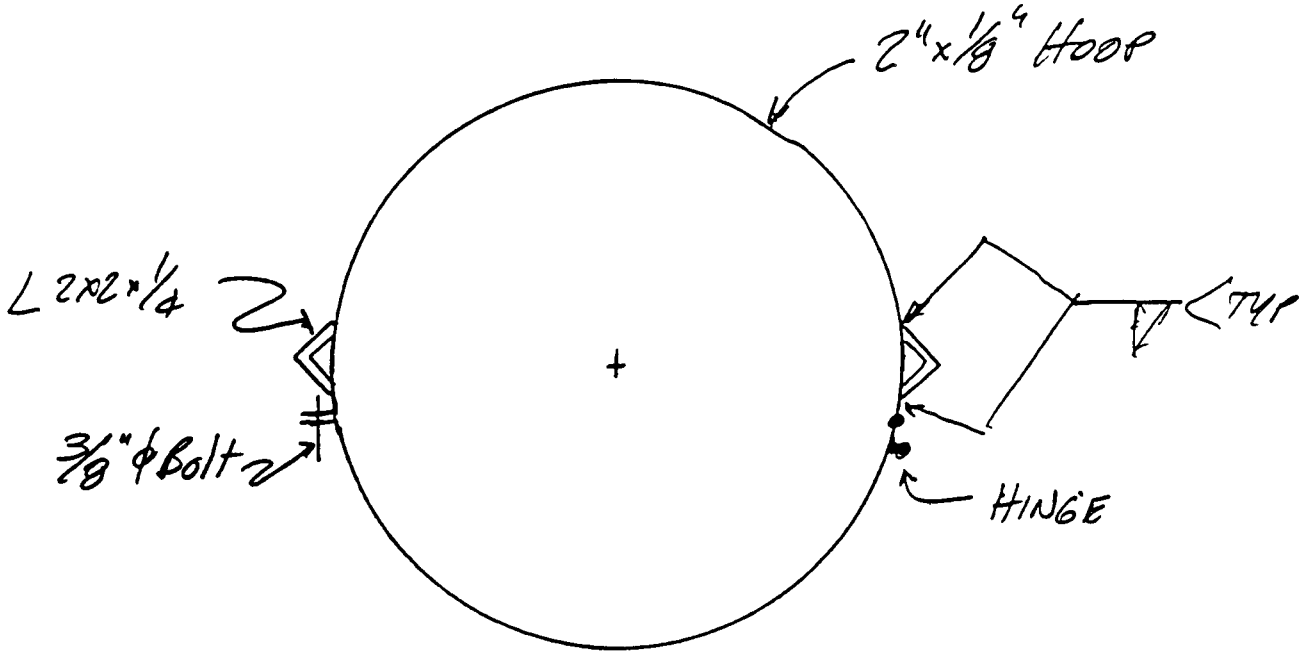
Base: USE $\frac{3}{8}" \times 4 \times 4$



CAPACITY: 1700# TENS
$>>$ 1124# OK


24.5"ϕ
2"x1/8" Hoop
L 2x2x1/4
A
B
30"
SEAL
PL 1/4"x 24 1/2"ϕ
6"
4'x4'x8" CONC PAD NOT SHOWN
3/16
2-12
L 2 1/2x2 1/2x1/4
L 2x2x1/4
L 2 1/2x2 1/2x 1/4 or 2 1/2x3/8 bar w/ cont weld
1/4" PL
4x4x1/2" PL (TYP)
TYP
3/16
3/16

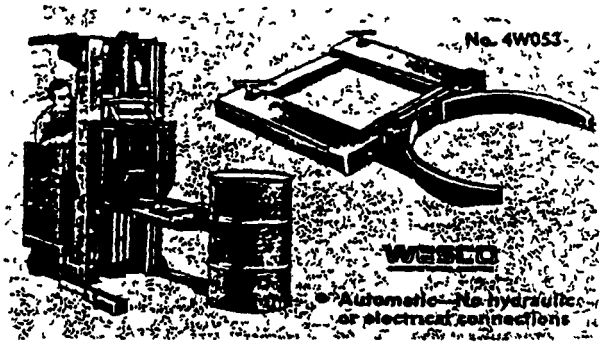
- SECTION A



SECTION B

16. Product Specification Sheets for Vertical Drum Lifter and Drum Dollies

FORK MOUNTED DRUM GRABS



Enable forklift operator to singlehandedly lift transport and deposit closed head steel drums Drum grabs may be utilized for open head steel drums which are not out of round or damaged or that contain materials that can spill Driver simply approaches drum lifts transports sets down and backs truck away Weight of drum holds grab jaws preventing slippage Mounts easily on forks of forklift All welded construction Jaws are formed from steel bar Safety orange enamel finish Wesco Mfg.

30/55-Gallon Drum Grabs adjust easily without tools to handle 30 or 55-gallon steel open or closed head drums. 1500 lb capacity units are secured to forks with hand tightened lock screws mounted on each fork pocket. Fork pockets 22" center to center Two drum model to be used only with two same size drums

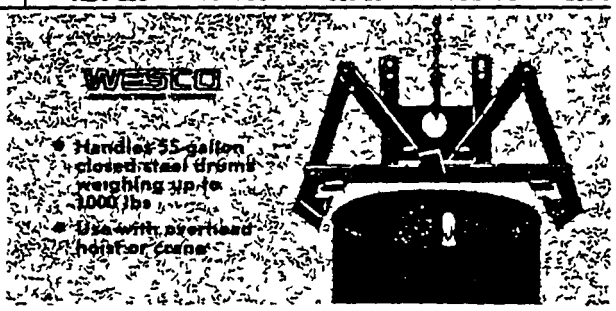
Standard 55-Gallon Drum Grabs. 1500 lb capacity per drum Choose from single or double drum models Both are secured to forks with hand-tightened lock screws mounted to each fork pocket. Fork pockets 22" center to center

Drum Grab Type	Drum Capacity No	Drum Capacity Gallon	Drum Capacity Diameter	Fork Pocket Size	Wesco Model	Stock No	List	Each	Shpg Wt
Standard	1	55	22½"	5½ x 2"	DJ-55	4W053	$422.40	$308 00	126 0
Standard	2	55	22½	7 x 2¼	DJ-255	4W466	564.70	461 00	230 0
Adjustable	1	30/55	18/22½	5½ x 2	ADJ-53	4W467	484.90	397 00	135 0
Adjustable	2	30/55	18/22½	7 x 2¼	ADJ 253	4W468	589 10	481 50	215 0

VERTICAL DRUM LIFTER

Automatic drum lifter picks up vertical standing 55-gallon closed steel drums and sets them down without operator at pickup or delivery point. Lifter works with operator's overhead hoist or crane. Lift hook from crane engages lifter; grabs and holds drum securely until drum is set down in place Lifter can be maneuvered over stacked drums and around obstacles to a selected drum, grab it, pick it up and carry it to another location with the operator safely out of the way Simple grab hook mechanism. Grip pads help align on drum chime for secure operation. Comes fully assembled 18½H x 33W x 8"D Orange enamel finish Wesco Mfg. brand (DL-1).

No. 3W391 Shpg. wt. 52.0 lbs. List $186 80 Each $141.20



WESCO ECONOMY DRUM LIFTER

- **For 55-gallon closed head steel drums**
- **700 lb lifting capacity**

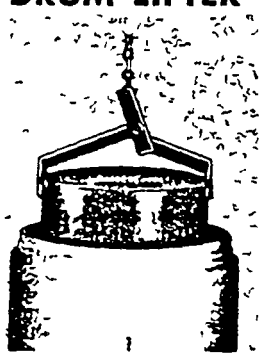
Vertical drum lifter is safe and simple to use on 55 gallon closed head steel drums Attach hook of any overhead crane or hoist through 1½" diameter lifting eye mounted on top of four 1/4 x 1" hot rolled steel supports Safety lock pin prevents accidental opening while transporting drums up to 700 lbs Overall dimensions 31½H x 23W x 28¼"D Wesco Mfg. brand (EDL-5)

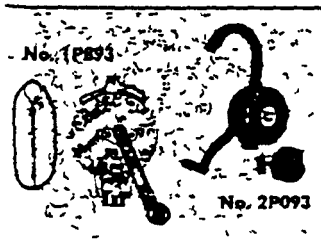
No 5W683 Economy Drum Lifter Shpg. wt. 15 0 lbs List $125 70 Each $96 20

WESCO SALVAGE DRUM LIFTER

Easy to use overhead drum lifter picks up vertical standing 55 and 85-gallon open and closed steel drums. All steel lifter has one moving part and easily grabs drum just below chime Special design enables lifter to place a damaged 55-gallon steel drum into tight clearance 85-gallon steel or poly salvage/overpack drum 1000 lb capacity Shipped unassembled Orange enamel finish Wesco Mfg. brand (SDL-85)

No 6W782 Salvage Drum Lifter Shpg wt. 21 0 lbs List $128 00 Each $90 10





ROTARY DRUM PUMPS

Hand operated drum pumps for dispensing and transfer pumping fuel oil lubricating oil gasoline anti-freeze No 1P893 delivers up to 10 gallons of fluid per 100 revolutions Includes 22 to 40" telescoping suction pipe and 2" bung adapter Pump body has 1" inlet and 3/4" outlet. No 2P093 delivers 10 GPM at 135 RPM 1" NPT inlet and 3/4" NPT discharge port. Bung adapter included Requires 1" NPT pipe suction tube For complete listings see pages 2498 and 2499 respectively

EAGLE

DRUM SAFETY STORAGE CABINET

No 3W372 manual closing 2-door cabinet for 55-gallon vertical drum storage of flammable liquids Eagle brand For ordering information see page 1901

Grainger No 386, 1995

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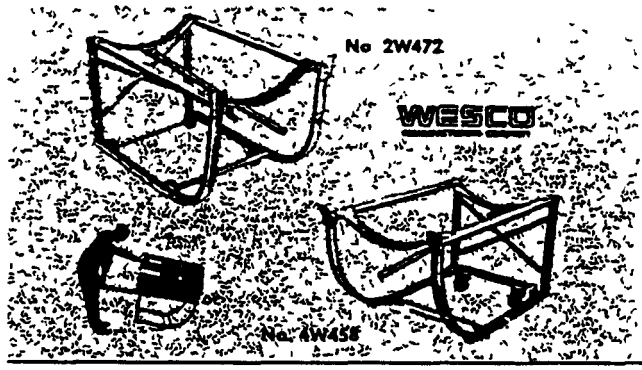
55-GALLON DRUM CRADLES



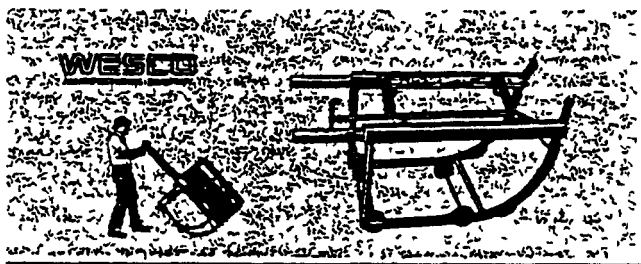
For manually handling 55-gallon steel drums Simplifies storage loading and unloading and on the job dispensing operations Four easy steps enable one operator to handle full loaded drums (1) Position cradle next to drum (2) Hook tipping lever on drum chime (3) Tip load on the curved rails (4) Move loaded cradle on its wheels to new location. Cradle frame is box channeled steel cross-braced for rigidity Nonsparking, oil and chemical resistant wheels standard on both models Load capacity 600 lbs, drain height 15" 32¼L x 19½"W Orange color Shipped unassembled. Wesco Mfg. Brand.

No. 2W472 has four 2½" rigid polyolefin wheels mounted inside the frame

No 4W458 has two 2½" rigid polyolefin wheels and two polyolefin swivel casters for easy steering.

Wheels	Casters	Wesco Mfg Model	Stock No	List	Each	Lots 3	Shpg Wt
4	—	CW-10	2W472	$98 70	$80 70	$76 67	30
2	2	CWS 10	4W458	132.00	98 50	95 58	37

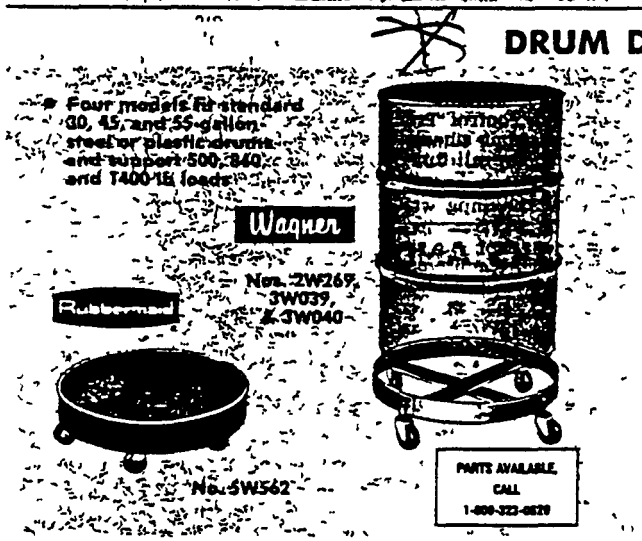
30 AND 55-GALLON INDUSTRIAL DRUM CRADLE



Drum cradle enables one operator to tip, move rotate drain and store industrial steel and fiber drums weighing up to 1000 lbs Handles either 30 or 55-gallon metal industrial drums with ease Two hardwood retractable handles extend from 42 to 64" giving operator leverage and safety when tipping drum down for draining. Horizontal position is 20" above floor surface Polyolefin rollers enable drum to be rotated for positioning. Drum hoop and beveled toes are made of long wearing carbon steel Cradle moves on four 4" polyolefin wheels that resist reaction with fats oil and chemicals. Unit comes partially assembled Top section has welded steel construction that bolts to the uprights 25½H x 19"W Orange Wesco Mfg brand (CW-20)

No. 3W399 Shpg. wt. 54.0 lbs-List $185.00 Each $137.20

DRUM DOLLIES



Add mobility to heavy industrial drums and enable reusable drums to serve as convenient containers for scrap metal, liquids, parts, and refuse

No 5W562 is of structural foam which will not rust or bend has a solid bottom, and comes with five heavy-duty casters Nos 2W269, 3W039 and 3W040 have a circular frame of welded steel with cross-bracing on the bottom and four heavy duty duo level ball bearing swivel casters Rubbermaid and Wagner brands

SPECIFICATIONS

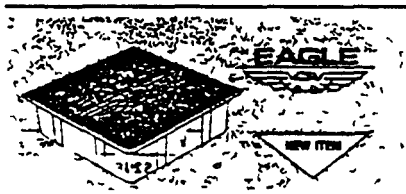
Dolly Capacity	Dolly Size Dia	Dolly Size In Dia	Dolly Size Ht	Caster Size	Caster Type
500 lbs	24⅜"	23½	7⅛"	3 x 1¼"	Rubber/Steel Plate
840	20⅜	19⅛	6¼	3 x 1¼	Molded Plastic
840	23½	23⅛	6¼	3 x 1¼	Molded Plastic
1400	23½	23⅛	6½	3 x 1¾	Phenolic Resin

DRUM DOLLY ORDERING DATA

Dolly Capacity	For Drum Size	Mfr s Model	Stock No	List	Each	Lots 3	Shpg. Wt
500 lbs	Up to 55 gal.	2650	5W562	$78.02	$66 30	$62 99	17 0
840	30	4866†	2W269	51 19	46 10	42 11	14.0
840	45 55	4000†	3W039	57.05	51 40	46 92	19 0
1400	45 55	4001†	3W040	92.17	83 05	75 81	20 0

( ) Rubbermaid brand. (†) Wagner brand

DRIP PAN



Absorbs problem leaks and helps keep work area floors clean and safe Holds up to one gallon of liquid Pan is filled with polypropylene sorbent for oils water based and other non aggressive liquids Rigid sturdy construction helps prevent spillage during handling. 10½ square 3" deep Packed 12 drip pans per box Eagle brand (1670)

No 5U734 Shpg wt 10 0 lbs. List $70 00 Each Box $52.50 Lots 4 $49 88

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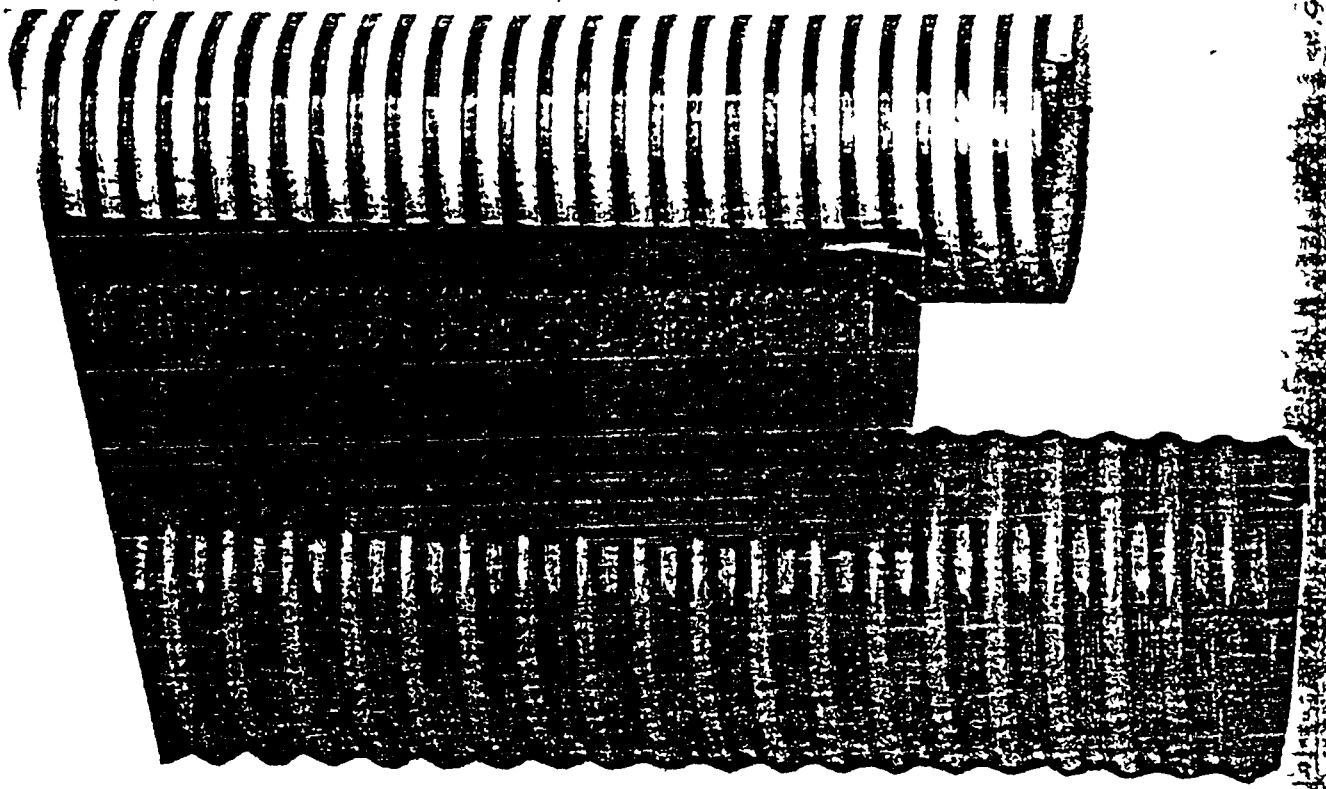
17. Product Specification Sheets for Flexible PVC Hose, Quick Disconnect Couplings, and Hose Clamps

KANAFLEX PVC SUCTION & DISCHARGE HOSE

Kanaflex is recognized as an industry leader in corrosion resistant hose products This suction and discharge hose is ideal in chemical, salt water, sludge and in the (200 series) food grade applications It s patented PVC helical coils make it crush resistant yet provides a smooth bore so as not to impede flow



SERIES 100CL

SERIES 110CL & 110GR

SERIES 110 HEAVY DUTY (GREEN OR CLEAR) SUCTION & DISCHARGE HOSE

PART NUMBER	I D (IN)	O D (IN)	MIN BENDING RADIUS 72°F (IN)	WORKING PRESSURE 72°F P S I	BURSTING PRESSURE 72°F P S I	VACUUM RATING 72°F IN./Hg	UNIT LENGTH (FT)	PRICE PER FT ($)
110PV-007KF	3/4"	0 95	1 9	86	284	29 8	100	80
110PV-010KF	1	1 23	1 9	86	284	29 8	100	1 07
110PV-012KF	1-1/4	1 52	2 7	79	256	29 8	100	1.37
110PV-015KF	1 1/2	1 78	2 8	72	242	29 8	100	1 55
110PV-020KF	2	2 38	3 9	72	242	29 8	100	2.27
110PV-025KF	2 1/2	2 92	4 7	72	242	29 8	100	3 53
110PV-030KF	3	3 41	6 1	62	199	29 8	100	4.26
110PV-040KF	4	4 50	9 1	55	178	29 8	100	7 10
110PV-050KF	5	5 55	14 0	33	120	28 0	50	10.27
110PV-060KF	6	6 67	15 0	33	120	28 0	50	13 40
110PV-080KF	8	8 83	20 0	28	105	28 0	25	23 02

SERIES 100 STANDARD DUTY (GREEN OR CLEAR) SUCTION & DISCHARGE HOSE

100PV-010KF	1	1 22	1 2	50	155	29 8	100	1 05
100PV 012KF	1 1/4	1 48	1 6	45	149	29 8	100	1.21
100PV-015KF	1 1/2	1 84	2 0	45	149	29 8	100	1 45
100PV-020KF	2	2 36	2 6	40	132	29 8	100	2.00
100PV-025KF	2 1/2	2 87	2 6	35	115	29 8	100	2.99
100PV-030KF	3	3 50	2 8	35	115	29 8	100	4 10
100PV-040KF	4	4 63	4 3	30	100	29 8	100	6 54
100PV-060KF	6[2]	6 73	9.2	30	100	28 0	50	13 10
100PV-080KF	8[2]	9 04	14 3	30	100	28 0	25	22.63
100PV 100KF	10[2]	11 26	30 0	30	80	28 0	20	48 09

NOTE Specify Clear or Green

1 Special order 100 minimum order 2 Available in clear only (green available by quotation)

QUICK DISCONNECT CAM OPERATING COUPLINGS

BLACK GLASS FILLED POLYPROPYLENE WITH EPT GASKETS STANDARD

These corrosion resistant fittings are designed for use in rugged applications where a piping system and hose or tubing may be connected and disconnected often. They are manufactured of glass filled polypropylene, and glass filled nylon is available on request. Our couplers mate with any other coupler, metal or plastic, manufactured to MIL-C-27487 dimensions. This specification has become the basic standard for cam type couplers.

TEMPERATURE RANGE
Normal Conditions.
From 10°F to 180°F

WORKING PRESSURES
1/4" thru 1" sizes - 125 PSI
1-1/4" thru 2" sizes - 100 PSI
3" size - 75 PSI
4" size - 50 PSI

PART A
MALE COUPLER x FPT

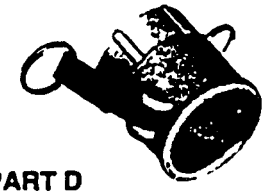
SIZE (IN)	PART NUMBER	PRICE EACH ($)
1/2	APP-005FL	2.20
3/4	APP-007FL	2.20
1	APP-010FL	2.70
1-1/4	APP-012FL	4 00
1-1/2	APP-015FL	4 00
2	APP-020FL	5 80
3	APP-030FL	7 00

PART B
FEMALE COUPLER x MPT

SIZE (IN)	PART NUMBER	PRICE EACH ($)
1/2	BPP-005FL	6 00
3/4	BPP-007FL	6 00
1	BPP-010FL	6 20
1-1/4	BPP-012FL	10 30
1-1/2	BPP-015FL	10.30
2	BPP-020FL	11 40
3	BPP-030FL	20 40

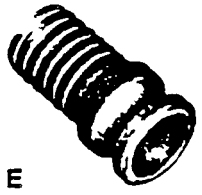
PART C
FEMALE COUPLER x HOSE

SIZE (IN)	PART NUMBER	PRICE EACH ($)
1/2	CPP-005LF	6 50
3/4	CPP-007FL	6 50
1	CPP-010FL	7 00
1-1/4	CPP-012FL	11 10
1-1/2	CPP-015FL	11 00
2	CPP-020FL	11 60
3	CPP-030FL	18 80



PART D
FEMALE COUPLER x FPT

SIZE (IN)	PART NUMBER	PRICE EACH ($)
1/2	DPP-005FL	6 50
3/4	DPP-007FL	6 50
1	DPP-010FL	7 00
1-1/4	DPP-012FL	11 40
1-1/2	DPP-015FL	11 30
2	DPP-020FL	12.00
3	DPP-030FL	20 00

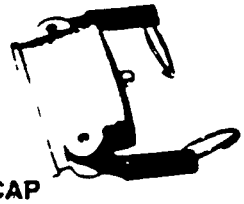


PART E
MALE COUPLER x HOSE

SIZE (IN)	PART NUMBER	PRICE EACH ($)
1/2	EPP 005FL	2 80
3/4	EPP-007FL	2.80
1	EPP 010FL	3 30
1-1/4	EPP-012FL	4 20
1-1/2	EPP 015FL	4 10
2	EPP 020FL	4 30
3	EPP 030FL	9 00

PART F
MALE COUPLER x MPT

SIZE (IN)	PART NUMBER	PRICE EACH ($)
1/2	FPP-005FL	2 80
3/4	FPP-007FL	2 80
1	FPP-010FL	3 40
1-1/4	FPP-012FL	4 20
1-1/2	FPP-015FL	4 10
2	FPP-020FL	4 30
3	FPP-030FL	11 00
4	FPP-040FL	28 00



PART DC
FEMALE CAP

SIZE (IN)	PART NUMBER	PRICE EACH ($)
3/4	DCPP-007FL	6 00
1	DCPP-010FL	6.30
1-1/2	DCPP-015FL	10 60
2	DCPP-020FL	11 00
3	DCPP-030FL	18 00
4	DCPP-040FL	32.00

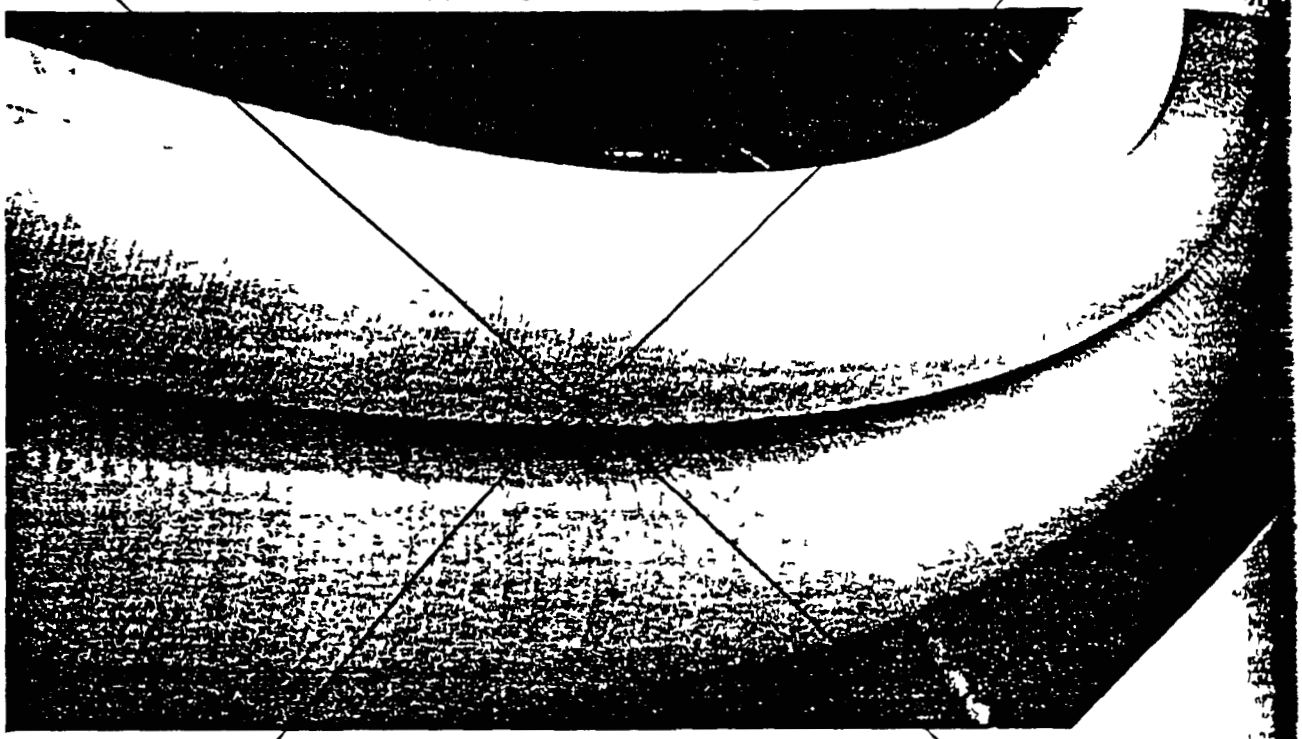
PART DP
MALE PLUG PART DP

SIZE (IN)	PART NUMBER	PRICE EACH ($)
3/4	DPPP 007FL	2 40
1	DPPP 010FL	2.50
1-1/2	DPPP-015FL	3 20
2	DPPP-020FL	3 50
3	DPPP-030FL	8 30
4	DPPP-040FL	20 00

KANAFLEX POOL & SPA PVC HOSE
PVC SOLVENT WELDED FLEXIBLE PIPE

Need a flexible connection between two PVC pipe connections? Here's your answer! This heavy duty tan suction hose is IPS size to solvent weld into standard PVC pipe fittings!

Approvals
IAPMO Listed SP1071, SBCCI, Southern California Building Code, City of Los Angeles, Metro Dade County



SPECIFICATIONS

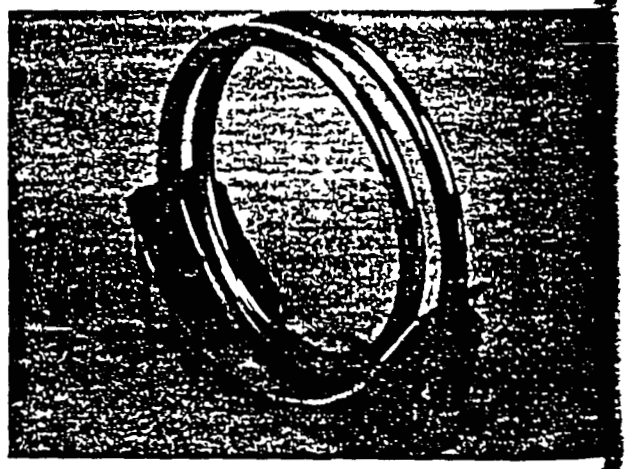
SIZE (IN)	O D (IN)	WALL THICKNESS (IN)	MIN BENDING RADIUS 72°F (IN)	WORKING PRESSURE 72°F P S I	BURSTING PRESSURE 72°F P S I	BURSTING PRESSURE 140°F P S I	COIL LENGTH (FT)	PART NUMBER	SPRIG PER FT. (1)
1/2	0 84	0 12	2	100	335	180	100	1/2-SPA	.82
3/4	1 050	0 13	2	100	355	180	100	3/4-SPA	1 13
1	1 315	0 14	2	100	355	220	50 OR 100	1-SPA	1 19
1-1/4	1 660	0 14	4	80	285	156	100	1-1/4-SPA	1.38
1-1/2	1 900	0 15	4	70	270	128	50 OR 100	1-1/2-SPA	1.55
2	2 375	0 16	5	64	230	100	50 OR 100	2-SPA	2.26

POWER LOCK CLAMPS

The Kanaflex "Power Lock" clamps are designed to accompany Kanaflex Hose Series 100, 155, and 180

POWER LOCK CLAMP

SIZE (IN)	PART NUMBER	PRICE EACH ($)
2	PLCP-020KF	9 93
2 1/2	PLCP-025KF	10 33
3	PLCP-030KF	10 73
4	PLCP-040KF	12.75
5	PLCP-050KF	16 38
6	PLCP-060KF	18 25
8	PLCP-080KF	28 18
10	PLCP-010KF	53 13
12	PLCP-120KF	70.30



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18. Product Specification Sheets Hydrogen Peroxide and Purge Meter

MATERIAL SAFETY DATA SHEET

ProTreat Technology Corporation
14818 West 6th Avenue, Suite 12A
Golden, Colorado 80401

(303) 279-1984

WT-961

Date Prepared: February 1, 1994

SECTION 1 - PRODUCT IDENTIFICATION

TRADE NAME: WT-961
Generic Name: Waterflood/Disposal Compound
DOT Proper Shipping Name: Cleaning Compound NOS Class 55
UN/NA Number: None
DOT Hazard Class: None

NFPA 704M Rating: 1 Health 2 Flammability 0 Reactivity 0 Other
0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

SECTION 2 - HAZARDOUS INGREDIENTS

The composition of this mixture may be proprietary information. In the event of a medical emergency, compositional information will be provided to a physician or nurse. This product is hazardous as defined in 29 CFR1910.1200, based on the following compositional information.

INGREDIENT(S)	CAS #	OSHA HAZARD
Diethylene glycol	111-46-6	OSHA PEL; ACGIH TLV
Methanol	67-56-1	Flammable
Isopropyl Alcohol	67-63-0	Inhalation irritant, flammable
Ethyl Alcohol	64-17-5	Inhalation irritant, flammable

SECTION 3 - PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point:	greater than 200° F
Specific Gravity:	.99
Vapor Density:	NA
Percent Volatiles by Volume:	appreciable
Appearance and Odor:	Amber Liquid; slight alcohol odor
Freezing Point:	-40° F
Vapor Pressure at 20° C:	NA
Solubility in Water:	soluble
Evaporation Rate:	NA
Stability:	Stable
Incompatibility:	Strong oxidizing agents

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Hazardous Polymerization:	Will not occur
Conditions to Avoid:	Avoid heat, sparks and open flames. Avoid contact with strong oxidizing agents.
Hazardous Combustion or Decomposition Products:	Carbon monoxide, ammonia, carbon dioxide, nitrogen oxides, and unidentified organic compounds may be formed during combustion.

NOTE: These physical properties are typical values for this product.

SECTION 4 - HEALTH EFFECTS INFORMATION

EYE CONTACT:
Can cause severe irritation.

SKIN CONTACT:
Repeated or prolonged contact causes drying, brittleness, cracking and irritation. Prolonged and repeated skin contact with methanol-soaked material has produced toxic effects including vision effects and death. Low toxicity to animals by skin contact (minimum lethal dose, monkeys: 1.6 g/kg).

INHALATION:
High vapor/aerosol concentrations (greater than approximately 1000 ppm) are irritating to the eyes and the respiratory tract, may cause headaches, dizziness, anesthesia, drowsiness, nausea, unconsciousness, and other central nervous system effects. May cause narcosis.

INGESTION:
Toxic. Causes headache, weakness, confusion, loss of coordination, dizziness, difficulty walking, nausea, vomiting, decreased blood pressure, increased heart rate, pulmonary edema, kidney failure, unconsciousness, convulsions, and coma. Symptoms may be delayed. Severe poisoning may cause death.

SYMPTOMS OF EXPOSURE:
ACUTE: Exposure to 4,000 - 13,000 ppm of methanol was fatal to humans.
CHRONIC: Exposure of 1,200 - 8,000 ppm of methanol for four years caused chronic poisoning and dimming of vision.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
Repeated overexposure may aggravate existing kidney disease. Repeated overexposure may aggravate or enhance existing nervous system dysfunction produced by disorders known to cause nervous system effects of damage such as diabetes, alcohol or drug abuse, and Parkinson's disease.
Because of its defatting properties, prolonged and repeated skin contact may aggravate an existing dermatitis (skin condition).

SECTION 5 - FIRST AID INFORMATION

EYE CONTACT:
Immediately flush with water for at least 15 minutes while holding eyelids open. Call a physician at once.

SKIN CONTACT:
Flush with large amounts of water; use soap if available. Remove grossly contaminated clothing, including shoes, and launder before reuse. If irritation occurs, get medical attention.

INHALATION:
Using proper respiratory protection, immediately remove the affected victim from exposure. Administer artificial respiration if breathing is stopped. Keep at rest. Call for prompt medical attention.

INGESTION:
If patient is conscious and can swallow, give two glasses of water (16 oz.). Induce vomiting as directed by medical personnel. Never give anything by mouth to an unconscious or convulsing person.

NOTE TO PHYSICIAN: No specific antidote is known. Based on the individual reactions of the patient, the physician's judgment should be used to control symptoms and clinical condition.

NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be needed.

SECTION 6 - OCCUPATIONAL EXPOSURE LIMITS

Diethylene glycol = TWA 50 ppm (total), 10 mg/m^3 (aerosol) AIHA/WEEL
Methanol = TWA 200 ppm, STEL 250 ppm (skin) ACGIH/TLV
260 mg/m3, 310 mg/m3 ACGIH/TLV
Isopropanol = TWA 400 ppm, STEL 500 ppm ACGIH/TLV
985 mg/m^3 1230 mg/m^3 ACGIH/TLV
Ethyl Alcohol = TWA 1000 ppm ACGIH/TLV
1000 ppm OSHA PEL

SECTION 7 - PERSONAL PROTECTION EQUIPMENT

RESPIRATORY PROTECTION: Airborne concentrations should be kept to lowest levels possible. If vapor, mist or dust is generated, use respirator approved by MSHA or NIOSH as appropriate. Supplied air respiratory protection should be used for cleaning large spills or upon entry into tanks, vessels, or other confined spaces.

VENTILATION: General ventilation is recommended. Additionally, local exhaust ventilation is recommended where vapors, mists or

aerosols may be released.
PROTECTIVE EQUIPMENT: Use impermeable gloves and chemical splash goggles when attaching feeing equipment, doing maintenance or handling product. Examples of impermeable gloves available on the market are neoprene, nitrile, PVC, natural rubber, viton and butyl (compatibility studies have not been performed).
Skin Protection: Workers should wash exposed skin several times daily with soap and water. Soiled work clothing should be laundered or dry-cleaned.

SECTION 8 - FIRE AND EXPLOSION INFORMATION

FLASHPOINT: 110 Deg F. METHOD: TCC NOTE: Minimum

FLAMMABLE LIMITS IN AIR, % by volume (methanol):
Upper: 36.5
Lower: 5.5

GENERAL HAZARD:
Combustible Liquid, can form combustible mixtures at temperatures at or above the flashpoint.
Static Discharge, material can accumulate static charges which can cause an incendiary electrical discharge.
"Empty" containers retain product residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner, or properly disposed of.

FIRE FIGHTING:
Use water spray to cool fire exposed surfaces and to protect personnel.
Isolate "fuel" supply from fire.
According to NFPA Guide, use foam, dry chemical, or water spray to extinguish fire.
Avoid spraying water directly into storage containers due to danger of boilover.
This liquid is volatile and gives off invisible vapors. Either the liquid or vapor may settle in low areas or travel some distance along the ground or surface to ignition sources where they may ignite or explode.
Firefighters must be equipped to prevent breathing of vapors or products of combustion. Wear an approved self-contained breathing apparatus and protective clothing.

HAZARDOUS COMBUSTION PRODUCTS:
May evolve NOx under fire conditions. Containers exposed in a fire should be cooled with water to prevent vapor pressure buildup leading to a rupture.

SECTION 9 - REACTIVITY INFORMATION

STABILITY: Stable
HAZARDOUS POLYMERIZATION: Will not occur
CONDITIONS TO AVOID: Heat, sparks, flame.
HAZARDOUS DECOMPOSITION PRODUCTS: None
INCOMPATIBILITY: Avoid contact with strong oxidizers (eg. chlorine, peroxides, chromates, nitric acid, perchlorates, concentrated oxygen, permanganates) which can generate heat, fires, explosions and the release of toxic fumes.
THERMAL DECOMPOSITION PRODUCTS: In the event of combustion CO, NOx, CO_2 may be formed. Heating in air may produce irritating aldehydes, acids, and ketones. Do not breathe smoke or fumes. Wear suitable protective equipment.

SECTION 10 - PRECAUTIONARY LABEL INFORMATION

WARNING: Harmful or fatal if swallowed. May cause kidney and nervous system damage. Contains methanol. May cause blindness if swallowed. Causes irritation to skin and eyes. Combustible. Prolonged inhalation of vapor may be harmful. Do not get in eyes, on skin or on clothing. Wear goggles and face shield when handling. Avoid prolonged or repeated breathing of vapor. Use with adequate ventilation. Do not take internally. Do not use, store, spill or pour near heat, sparks or open flame. Wash thoroughly with soap and water after handling. Wash contaminated clothing thoroughly before re-use. Discard contaminated leather clothing. KEEP OUT OF REACH OF CHILDREN. Keep container closed when not in use. Ground all equipment to prevent accumulation of static charge.

Empty containers may contain residual product. Do not reuse container unless properly reconditioned.

SECTION 11 - SPILL AND DISPOSAL INFORMATION

SPILL CONTROL AND RECOVERY:
Those responsible for control and recovery should wear protective equipment. If it is possible to generate vapors or mists, a NIOSH approved respirator is recommended.
Eliminate sources of ignition. Prevent additional discharge of material.
Small liquid spills: Contain with absorbent material, such as clay, soil or any commercially available absorbent. Shovel reclaimed liquid and absorbent into recovery or salvage drums for disposal.

Large liquid spills: Dike to prevent further movement and reclaim into recovery or salvage drums or tank truck for disposal.

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Prevent liquid from entering sewers, watercourses, or low areas. Contain spilled liquid with sand or earth. Do not use combustible materials such as sawdust.
Recover by pumping (use an explosion proof or hand pump) or with a suitable absorbent.

Dispose in accordance with local, state and federal regulations. Use qualified disposal company to incinerate, or otherwise discard, at an approved facility.

DISPOSAL: If this product becomes a waste, it meets the criteria of a hazardous waste as defined under the Resources Conservation and Recovery Act (RCRA) 40 CFR 261. Hazardous Waste D001.

As a hazardous liquid waste, it must be solidified with stabilizing agents (such as sand, fly ash, or cement) so that no free liquid remains before disposal to a licensed industrial waste landfill (Hazardous Waste Treatment, Storage and Disposal facility). A hazardous liquid waste can also be deep-well injected in accordance with local, state, and federal regulations.

SECTION 12 - REGULATORY INFORMATION

The following regulations apply to this product:

TOXIC SUBSTANCES CONTROL ACT (TSCA):
The chemical ingredients in this product are on the 8(b) Inventory List (40 CFR 710).

CERCLA/SUPERFUND, 40 CFR 117, 302:
This product contains methanol, a Reportable Quantity (RQ) substance and if 24,000 pounds of product are released, it requires notification to the NATIONAL RESPONSE CENTER, WASHINGTON, D.C. (1-800-424-8802).

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III) - SECTIONS 302, 311, 312 AND 313:

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355):
This product does not contain ingredients listed in Appendix A and B as an Extremely Hazardous Substance.

SECTION 311 and 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370):
Our hazard evaluation has found this product to be hazardous. The product should be reported under the following EPA hazard categories:

X Immediate (acute) health hazard
X Delayed (chronic) health hazard
X Fire hazard
__ Sudden release of pressure hazard
__ Reactive hazard

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372):
This product contains the following ingredient(s), (with CAS # and % range) which appear(s) on the List of Toxic Chemicals.

Component	CAS NO.	MAXIMUM %
Methanol	67-56-1	16.0

California Proposition 65:
This product contains no known chemicals known to the State of California to cause cancer or reproductive toxicity.

SECTION 13 - USER'S RESPONSIBILITY

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to ensure safe workplace operations. Please consult your local sales representative for any further information.

SECTION 14 - DISCLAIMERS

Some of the information presented and conclusions drawn herein are from sources other than direct test data on the product itself.

The information in this MSDS was obtained from sources which we believe are reliable. However, the information is provided without any warranty, express or implied, regarding its correctness.

The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product.

This MSDS was prepared and is to be used only for this product. If the product is used as a component in another product, this MSDS information may not be applicable.

This MSDS has been prepared in accordance with the requirements of the OSHA Hazard Communication Standard (29 CFR 1200).

Date Prepared: Feb 1, 1994

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CONTROL OF MICROBIAL ACTIVITY

Knowledge of the behavior of microorganisms in water is extremely important, since their presence can cause corrosion or plugging of equipment or the injection wellbore.

Corrosion problems mainly arise from the presence of sulfate-reducing bacteria (SRB), slime-forming bacteria, iron-oxidizing bacteria, acid-producing bacteria, and sometimes other miscellaneous organisms, including algae, sulfur bacteria, yeasts, and molds.

Bacteria, the largest group of troublesome organisms, cause the most varied problems. They are usually classified in water treatment by the types of problems they cause: slime-forming bacteria, iron-depositors, sulfate-reducers, and nitrifying bacteria. Each group has its preferred environment and thrives in specific areas of a water system.

The reason that bacteria can create so much trouble for us is that they can multiply with incredible speed. They can double their population in 20 minutes under many conditions, which means that a single bacterium can become a thriving colony of millions of bacteria in a very few hours. A handful of slime from a water may contain as many bacteria as there are people in the world.

Bacteria flourish under an extremely broad range of conditions, although they grow best in the pH range of 5 to 9 and at temperatures of -18 to 80°C. They also prefer fresh water, but can do nicely in brines. Bacteria have been found in packer fluids at 2500 m and in soil in the High Arctic. They are very hardy.

Until recently, it was believed that the anaerobic SRB caused the majority of the problems with respect to microbiological corrosion. As a result, most of the research was focused in this area. However, it is now apparent that facultative (bacteria that can grow in either the presence or absence of free oxygen) anaerobic organisms are as important as obligate (restricted to a particular environment) anaerobic organisms. It is recognized that mixed populations of bacteria contained in a biofilm are the most damaging. As a biofilm forms, aerobic organisms in the outer layers of the film create an anaerobic environment at the base of the film. The aerobes, in turn, produce metabolites that increase the activities of the anaerobes. The biofilm's layered structure enables it to support vigorous growth of a diverse community of bacteria. The primary challenge today is to establish methods to monitor sessile bacteria (bacteria that attach to a surface) as well.

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TYPES OF BACTERIA

Sulfate Reducing Bacteria

Sulfate reducers (Desulfovibrio Desulfuricans) probably cause more serious problems in oilfield injection systems than any other bacteria. They reduce sulfate ions in the water to sulfide ions, resulting in H_2S as a by-product.

Sulfate reducing bacteria live in groups or colonies on the pipe wall, and pits occur wherever they reside. Bacteria find it much easier to colonize on the pipe wall than in a moving stream of fluid. Any time you find bacteria in the water this means that there are many, many more securely attached to the walls of the piping and tankage.

Sulfate reducing bacteria are most likely to be found in stagnant or low velocity areas, and beneath scales or sludges. Common places for bacterial activity in injection systems are tanks, filters and the rat hole in injection and water source wells.

Sulfate reducing bacteria are anaerobic bacteria. However, they are quite capable of thriving in oxygenates systems, providing that they can find some scale or sludge to congregate under. Here they can usually find a sufficiently oxygen-free environment to live happy, healthy lives. Bacteria are very difficult to kill if they are effectively shielded by scale or debris.

Iron Bacteria

Iron bacteria deposit a sheath of ferric hydroxide around them as they grow. The iron is obtained from soluble iron ions in the water. Examples of iron bacteria are Siderocapsa, Gallionella, Sphaerotilus and Crenothrix. They are classified as aerobic bacteria, although they can apparently grow well with only trace amounts of oxygen.

Iron bacteria can cause both corrosion and plugging. Although they do not directly participate in the corrosion reaction, corrosion can result either from the activity of sulfate reducers under the hydroxide sheath or by the creation of an oxygen concentration cell.

Large number of iron bacteria can precipitate a sufficient quantity of ferric hydroxide to cause severe plugging problems.

Slime Formers

Slime forming bacteria are a general class of bacteria capable of producing dense masses of slime on solid surfaces. Examples are Pseudomonas, Flavobacterium, Aerobacter, Escherichia, and Bacillus. They are magnificent pluggers and contribute to corrosion in the same ways as iron bacteria by shielding part of the surface. Slime can be expected in either brine or fresh water systems, although they are more common in waters of low salinity.

Slime forming bacteria may be found in either aerobic or anaerobic system. However, they are more generally a problem in aerobic systems.

Typical Microorganisms and Their Associated Problems

Type of organism	Type of problem
A. Bacteria	
1. Slime-forming bacteria	Form dense, sticky slime with subsequent fouling. Water flows can be impeded and promotion of other organism growth occurs.
2. Iron-depositing bacteria	Cause the oxidation and subsequent deposition of insoluble iron from soluble iron.
3. Sulfate-reducing bacteria	Generate sulfides from sulfates and can cause serious localized corrosion.
4. Anaerobic corrosive bacteria	Create corrosive localized environments by secreting corrosive wastes. They are always found underneath other deposits in oxygen deficient locations.
B. Fungi	
Yeasts and molds	Cause the degradation of wood in contact with the water system. Cause spots on paper products.
C. Algae	
	Grow in sunlit areas in dense fibrous mats. Can cause plugging of distribution holes on cooling tower decks or dense growths on reservoirs and evaporation ponds.

GLASS TUBE TYPE PURGE METER INSTRUCTION SHEET
1-1/2 AND 3 INCH MODELS

GENERAL

This instruction sheet provides installation, operation and maintenance instruction for the Wallace & Tiernan Glass Tube Type Purge Meters which are furnished in two scale lengths, 1-1/2 or 3-inch, with or without control valves. A flow controller (accessory item) is available for use with the purge meter with control valve. Purge meters are available for use with 316 stainless steel frames, with wetted parts (and fittings) of 316 stainless steel. O-ring seals may be either Buna-N, Viton or EPR as desired. Control valve stems are furnished either with knobs for hand operation or with slots for screwdriver adjustment. All parts are readily replaceable and completely interchangeable. An integral check valve is standard on the no valve and valve bottom configurations.

WARNING: TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT, THIS EQUIPMENT SHOULD BE INSTALLED, OPERATED AND SERVICED ONLY BY TRAINED, QUALIFIED PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE ENTIRE CONTENTS OF THIS INSTRUCTION BOOK.

WARNING: THE FOLLOWING SAFETY RELATED PRECAUTIONS MUST BE OBSERVED:
1. FLUID: DO NOT USE GLASS TUBE METERS FOR TOXIC OR HAZARDOUS FLUIDS OR FLUIDS THAT ATTACK GLASS. REFER TO W&T CAT. NO. 500,001 FOR CHEMICAL COMPATIBILITY AND MATERIAL SELECTION IF APPLICATION IS TO BE CHANGED.
2. OPERATING PRESSURE: DO NOT EXCEED OPERATING PRESSURE AND TEMPERATURE LIMITS PRESENTED IN THIS INSTRUCTION SHEET.
3. TUBE SHIELD: ALWAYS USE FRONT TUBE SHIELD PROVIDED TO PROTECT OPERATOR IN THE EVENT OF TUBE BREAKAGE.
4. RELIEVE PRESSURE AND DRAIN SYSTEM BEFORE SERVICING.

INSTALLATION

All connections are 1/4" NPT. The outlet connection must be at the top.

PRESSURE/TEMPERATURE LIMITS			
TUBE RETAINER	O-RINGS	PRESSURE (PSIG)	TEMPERATURE (°F)
Kynar	Buna-N	200	200
Kynar	Viton	200	200
316 S.S.	Viton	250	250
Kynar	EPR	200	200
316 S.S.	EPR	250	250

DISASSEMBLY AND ASSEMBLY

1. Compress the shield slightly to disengage the lugs on one side of the shield from the slots in the frame. Lift the free side out and remove the shield from the frame.
2. Rotate nut from left to right until it is all the way up
3. Lift metering tube and retainer. Pull out bottom of tube to remove.
4. To remove check stem, turn metering tube retainer until the notch permits the retainer to pass the tab in the frame.
5. To avoid possible damage to valve stem or valve seat, always have control valve in open position before removing or installing valve stem adapter or seat.
6. For valve stem removal, first remove control valve stem adapter from meter. Remove knob from valve stem, then thread stem inward through adapter.
7. If O-rings are swollen, cracked or hardened, remove and replace. Apply a thin coating of silicone grease U10242 to the new O-rings to facilitate meter assembly and disassembly.

WARNING: WHEN USED IN OXYGEN SERVICE, TO AVOID SEVERE PERSONAL INJURY DUE TO FIRE OR EXPLOSION, LUBRICATE ONLY WITH HALOCARBON LUBRICANT U22886.

8. When reinstalling tube, tighten tube nut moderately, and rotate tube to aid engagement of O-rings Check that O-rings are not pinched and full contact line is visible through ends of glass tube.

INVERTING THE PURGE METER WITH CONTROL VALVE

1. Remove the metering tube retainer and the check-valve stem from the meter. Discard the check-valve and reinstall the retainer
2. Install the metering tube with the bottom of the scale toward the metering tube retainer
3. If the meter is for AIR-HIGH CAPACITY, the metering tube retainer must be changed (see table) and the NF 102 flow insert installed on the new retainer.
4. If a check valve is required for a particular system, a check valve similar to Nupro, Cat. no. SS-4CE5-1/3 can be installed on the meter outlet.

PARTS ORDERING INFORMATION

The complete ordering number of the meter is marked on the back of the frame when the meter is assembled in the factory. This number is applied in such a way that, if field changes are made, the number may be removed or changed to suit.

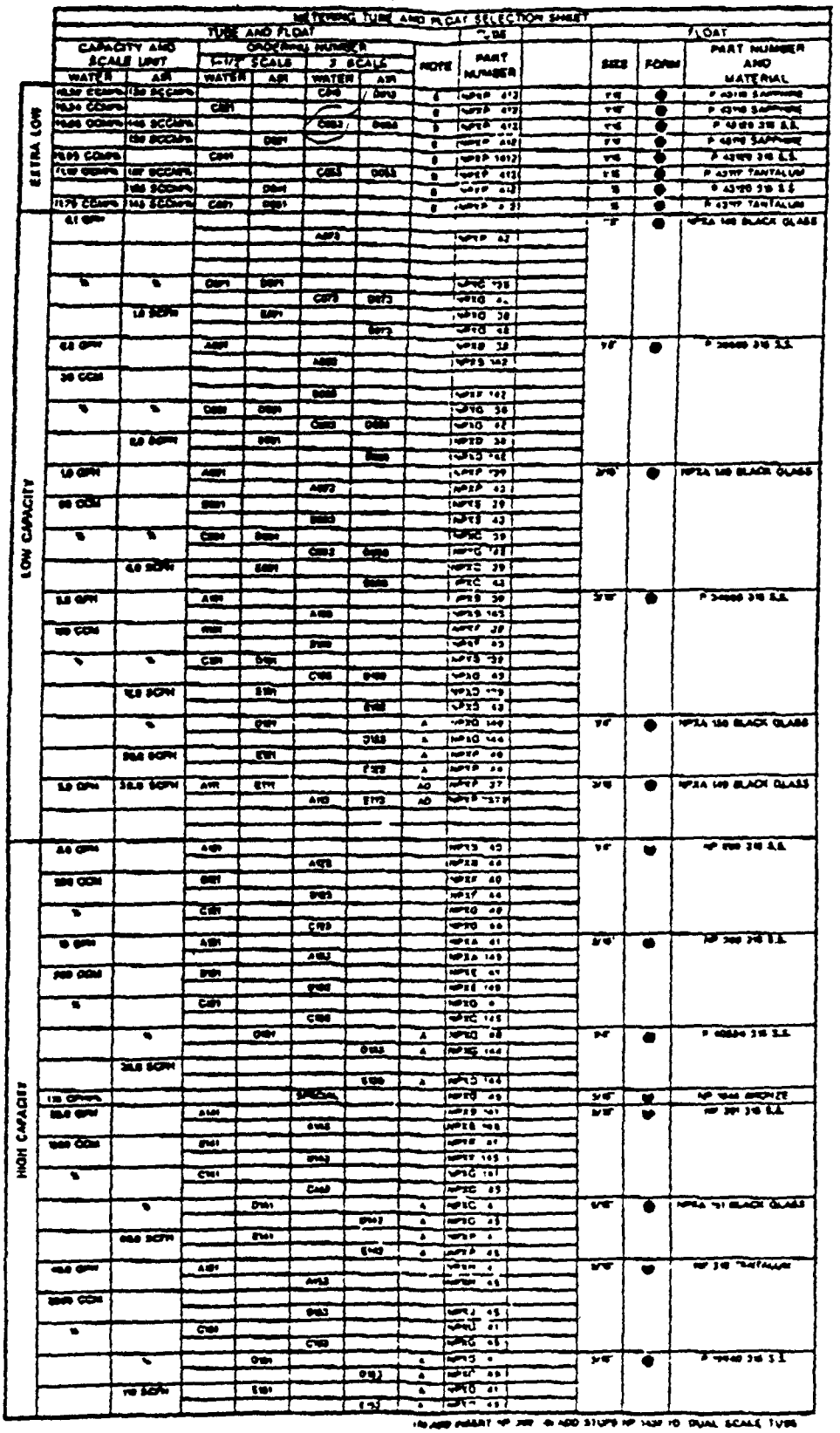
The first two digits of the ordering number identify the frame and fittings as shown in the table on page 2 and the letter with the next four digits identifying the tube and float as shown in the table on page 3.

WARNING: TO ENSURE PROPER AND SAFE OPERATION OF THIS EQUIPMENT, USE ONLY W&T LISTED PARTS EXCEPT FOR COMMERCIALLY AVAILABLE PARTS AS IDENTIFIED BY COMPLETE DESCRIPTION ON PARTS LIST THE USE OF UNLISTED PARTS CAN RESULT IN EQUIPMENT MALFUNCTIONS CAUSING POSSIBLE SEVERE PERSONAL INJURY.

The following label has been attached to the equipment and is listed below

WARNING LABEL: L2099 SEE INSTRUCTIONS FOR PRECAUTIONS TO AVOID INJURY DO NOT OPERATE WITHOUT SHIELDS

.003



METERING TUBE AND FLOAT SELECTION SHEET													
	TUBE AND FLOAT							TUBE		FLOAT		
	CAPACITY AND SCALE UNIT		ORDERING NUMBER				NOTE	PART NUMBER		SIZE	FORM	PART NUMBER AND MATERIAL
			1-1/2" SCALE		3" SCALE							
	WATER	AIR	WATER	AIR	WATER	AIR						
EXTRA LOW												
LOW CAPACITY												
HIGH CAPACITY												

510.100.000 002C
ISSUE 5

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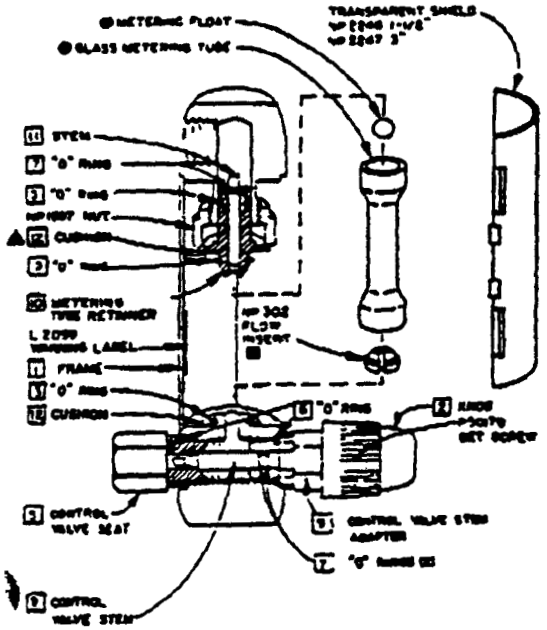
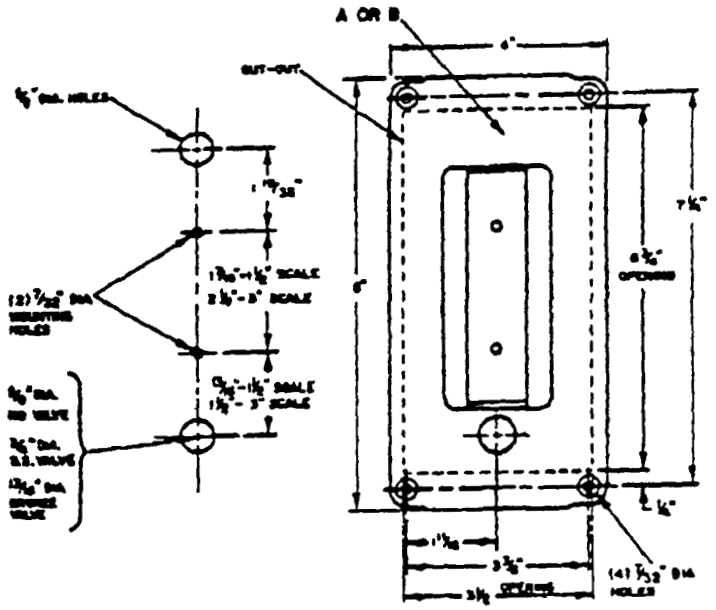
FLOW CONTROLLERS

CAP	MODEL NUMBER INLET	MODEL NUMBER OUTLET	MAX. CAPACITIES AIR FLOW SCFM	MAX. CAPACITIES H_2O GPM	MAX TEMP °F	MAX INLET PRESS. PSI	MIN PRESS. DROP PSI	MATERIALS OF CONTRUCTION BODY	DIAPH	STEM
LOW	5830	5840	30	5	200	200	6	BRASS	BUNA-N	316SS
	5810	5820	30	5	250	200	6	316SS	TEFLON	316SS
HIGH	5870	5880	110	40	200	200	8	BRASS	BUNA-N	316SS
	5850	5860	110	40	250	200	8	316SS	TEFLON	316SS



ISSUE 7
510.100.000.002A



ISSUE 4
510.100.106.000

(A) NU-129 BEZEL FOR METER WITHOUT CONTROL VALVE
(B) NU-130 BEZEL FOR METER WITH CONTROL VALVE

GUARANTEE AND WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. The exclusive remedy for any breach of the warranty is the replacement f.o.b. shipping point of the defective parts. If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 16 months after the date of shipment of the equipment or material. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder except that this exclusion shall not apply to chlorination equipment. Buyer does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, and (c) any other abuse or misuse by Buyer. SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER. Seller shall not be liable for any incidental or consequential damages arising from the use or use of the equipment or material. Where circumstances permit, Seller will implee, for the benefit of Buyer, the guarantee or warranty of Seller's vendor for equipment or materials furnished hereunder. In the event the equipment or material furnished hereunder shall be used in any capacity in connection with any nuclear facility Buyer agrees to hold Seller harmless from all claims for damages arising out of injury or death to any person or damage to or destruction of the nuclear facility or any other property or loss of use of any such property whether such person or property is on or off the installation or activity site for which the equipment or material furnished hereunder is destined and whether such damage, loss, destruction or loss of use, injury or death results directly or indirectly from a nuclear incident or from any other cause.

Statements and instructions set forth herein are based upon the best information and practices known to Wallace & Tiernan, Inc., but it should not be assumed that every acceptable safety procedure is contained herein. Or necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

19. Product Specification Sheets for PVC Liner

Colorado Lining COMPANY

Phone: (303) 841-2022 Fax: (303) 841-5780

1062 Singing Hills Road, Parker, Colorado 80134

40 MIL PVC GEOMEMBRANE LINER

Property	Test Method	Required NSF 54	Typical Values
Gauge (nominal)	————	40	
Thickness Mils (minimum)	ASTM D1593	38	39.5-40 5
Specific Gravity (minimum)	ASTM D792	1.20	1.280
Minimum Tensile Properties (each direction)	ASTM D882		
1. Breaking Factor (pounds/inch width)	Method A (1 inch wide)	92	MD 120 TD 115
2. Elongation at break (%)	Method A (2" jaw separation)	350	MD 500 TD 550
3. Modulus (force) at 100% elongation (pounds/inch width)	Method A	36	MD 60 TD 55
Tear Resistance (pounds, minimum)	ASTM D1004 Die C	10	MD 15 0 TD 16 0
Low Temperature, °F	ASTM D1790	-20	Pass
Dimensional Stability (each direction, % change maximum)	ASTM D1204 212°F, 15 min	Less than 5%	Pass
Water Extraction (% loss maximum)	ASTM D3083 (as modified in Annex A)	0.35	0 11 -
Volatile Loss (% loss maximum)	ASTM D1203 Method A	0 50	0 40
Resistance to Soil Burial (% change maximum in original value)	ASTM D3083 (as modified in in Annex A)		
1 Breaking factor		± 5%	Pass
2 Elongation at break		± 20%	Pass
3 Modulus at 100% elongation		± 20%	Pass
Hydrostatic Resistance (pounds/sq in min)	ASTM D751 Method A	82 (110)*	157

* Proposed Value

Colorado Lining COMPANY

Phone: (303) 841-2022 Fax: (303) 841-5780

1062 Singing Hills Road, Parker, Colorado 80134

INSTALLATION PREPARATION GUIDE

1. Subgrade upon which liner is to be placed must be smooth and free from sharp rocks, roots, vegetation, and other foreign materials.

2. Dig anchor trench as shown on shop drawings or engineered drawings. Always take dirt to outside of trench.

3. Sandbags are required to keep panels in place during installation--minimum of 25 bags per panel.

4. Tools and equipment include: wiping rags, paint brushes 3" or 4", handling bar 3" or 4" schedule 40-10', scissors, 1-gallon buckets.

5. All PVC liners should be covered if extended life is expected Side slopes should be no steeper than 3 to 1. Material will last up to 5 years exposed, 20 years covered.

6 Driving on liner is permitted only with 12" dirt cover on lining. No sharp turns or excessive speeds allowed.

7. Structures, piping, concrete, drains, and any associated work should be completed prior to lining installation.

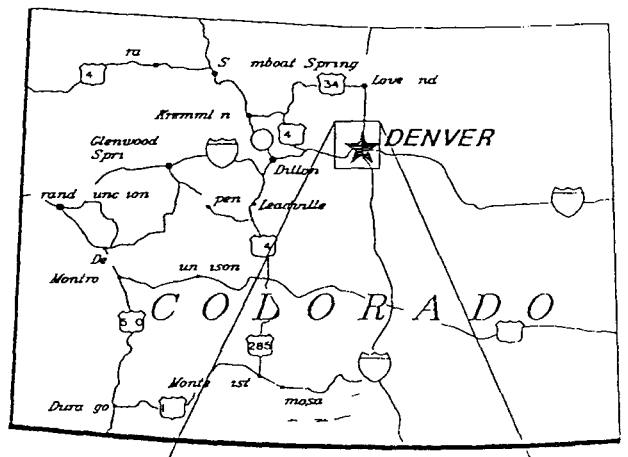
8. Care should be taken to avoid wrinkles in the seam areas and around mechanical attachments.

9. Take time when unloading and placing rolls of lining to avoid damage. Verify location of sheet before unrolling and placement to avoid improper alignment.

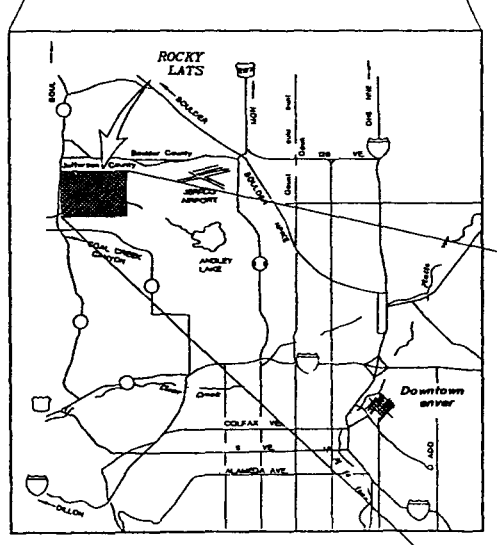
10 If problems or questions arise, contact Colorado Lining Company for assistance, (303) 841-2022 or (800) 524-8672.

OPERABLE UNIT NO 7 PASSIVE SEEP COLLECTION AND TREATMENT SYSTEM
DRAFT TITLE II DESIGN DRAWINGS
SEPTEMBER 21 1995
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
U S DEPARTMENT OF ENERGY

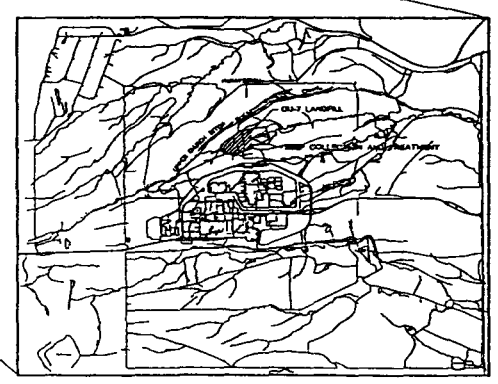
GOLDEN COLORADO



LOCATION MAP



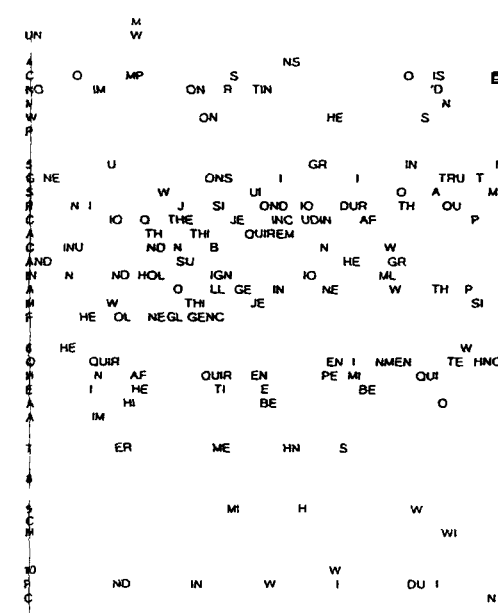
VICINITY MAP



SITE PLAN

DRAWING INDEX

DRAWING N	DESCRIPTION
0101	COVER SHEET
0102	SITE LAYOUT PLAN AND PROFILE
0103	PASSIVE TREATMENT SYSTEM PLAN AND SECTIONS
0104	PASSIVE TREATMENT SYSTEM DETAILS
0105	PASSIVE TREATMENT SYSTEM DETAILS
0106	PASSIVE TREATMENT SYSTEM DETAILS
0107	ELECTRICAL SCHEMATIC



Stoller
established 1959
The S.M. Stoller Corporation
700 Flatiron Parkway
Boulder Colorado 8030 -5
(303 449-7220

KEYWORDS	A	ORIGINAL SUE			9/ / 5 JL		SCALE		989035 2510-012
OU	U	D			TE		DOE	SI	JO NO.
2. LEACH	COLERA CES			TE	U S DEPARTME T OF ENER Y				
3 REMEDIAL ACTION	FRA ANGLE +	DESIGNED	JANKOUSKY	9/95	ROCKY FLA OFFICE GOLDEN, COLORADO				
5	DE UNLESS NOTED THE SE	WN	CONRATH	9/95	O VI ONM				
BUILDING ACUITY 5 te	REMOVE BURRS AND SHAR EDGES	CHECKED	CARUSO	9/95	GOLDEN COLORADO				
ROOM AREA		APPROVED	JANKOUSKY	9/95	OPERABLE UNI SSIVE SEEP COLLE TION AND TREATMEN SYSTEM				
GRID COORD COL NO.	NEXT ASSEMBLY	REVISION	CARTER	9/95	VE HE				
	SC LE.	SUBMITTED		9/12/95	ZE	D WI NU E		ISSUE	SHEE
		APPV RFP		9/12/95	D	5 267-0 0		A	1 OF 7
		APPV DOE							

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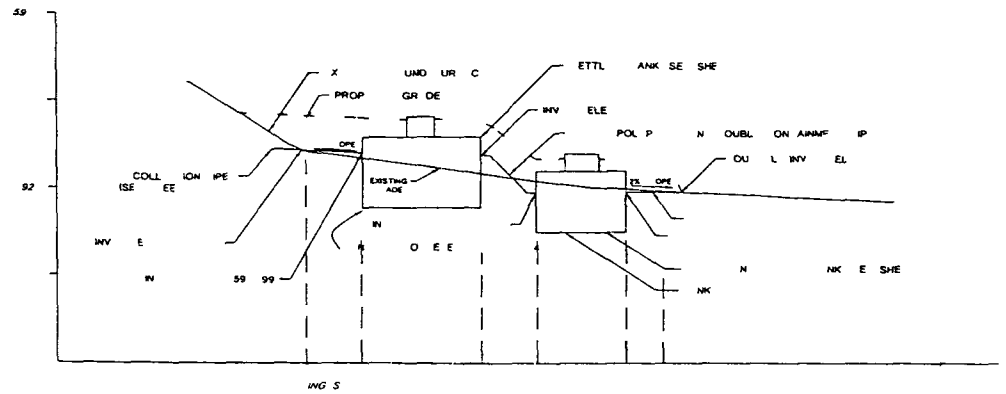
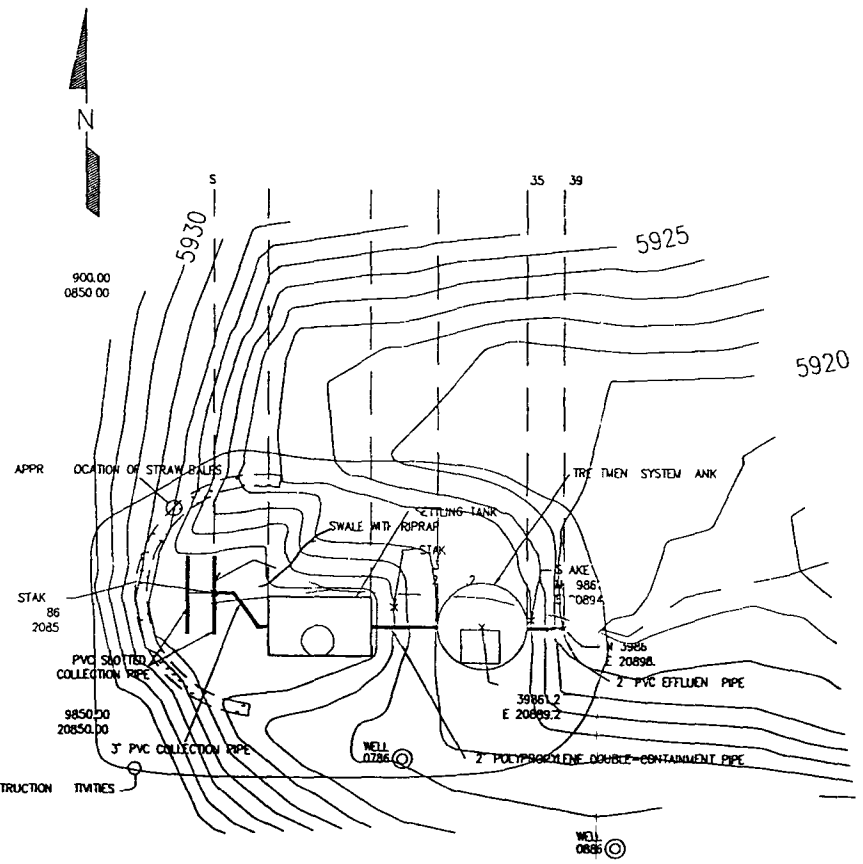
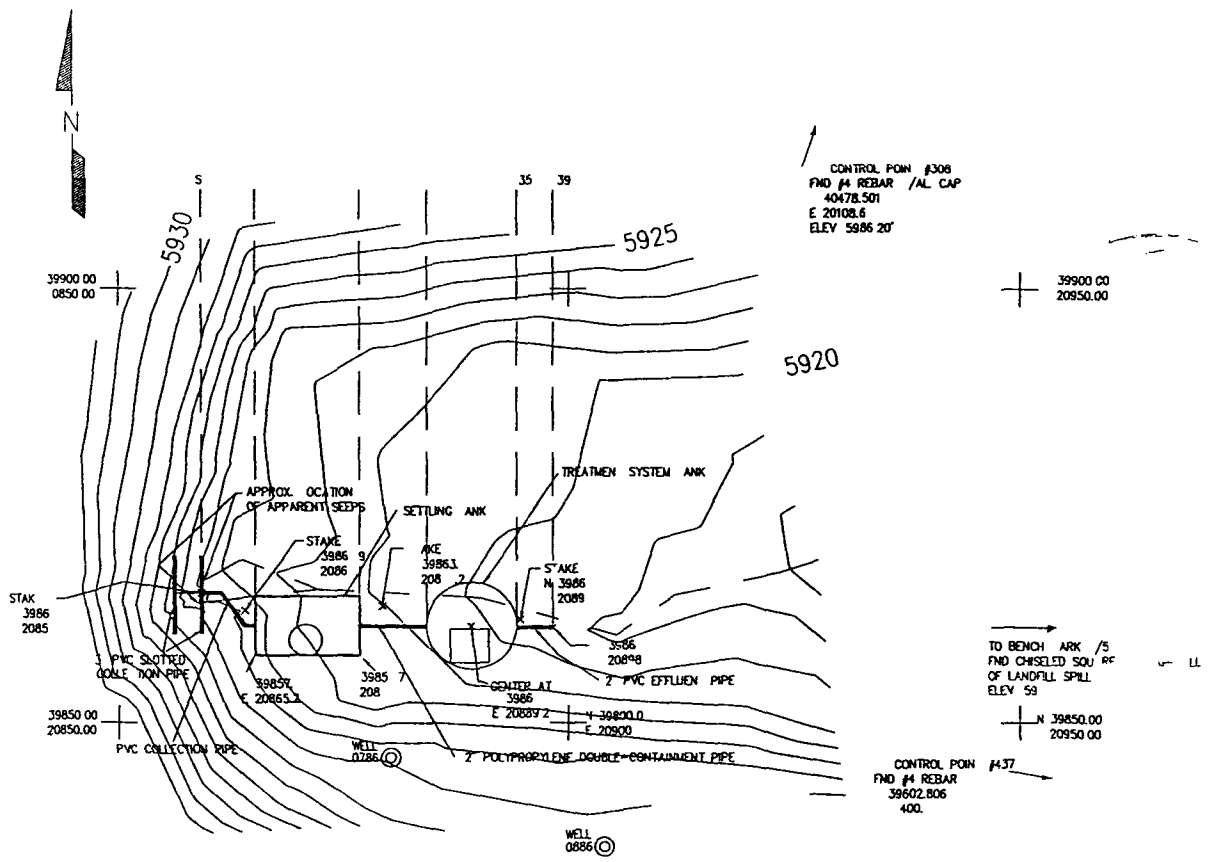


SITE LAYOUT– PROFILE



SITE LAYOUT – PLAN VIEW WITH PROPOSED GRADING CONTOURS AND EXTENT OF CONSTRUCTION



SITE LAYOUT– PLAN VIEW OF SYSTEM SUPERIMPOSED ON EXISTING ^PADE

KEYWORDS	A	ORIGINAL ISSUE			9/ /95	RJJ	SCJ	RJJ		989035
OU	U	IDE	ION		TE		F	DOE	CL S	JO NO
2 LEACH				TE						2510-6.2
3 REMEDIAL ACTION		DESIGNED	MARCUSKY	9/ /95	US DEPARTMENT OF ENERGY					
4 AM		DRWN	CDMRA	9/ /95	ROCKY FLA OFFICE GOLDEN COLORADO					
5		CHCKED	CARUSO	9/ /95	DC Environmental Geology					
BUILDING ACILITY		APPROVED	MARCUSKY	9/ /95	GOLDEN COLORADO					
Site		REVIEWED	PICKEREL	9/ /95	OPERABLE UNI ASSIVE SEEP COLLECTION AND TREATMEN SYSTEM					
ROOM AREA					SITE LAYOUT PLA ND ROFILE					
GRID COORD COL NO.	NEXT ASSEMBLY	REVISION	CARTER	9/ /95	TE	WI NU B			ISSUE	SHEET
		SUBMITTED			D	51267–0102			A	2 OF 7
	SCALE	APPV RFP		9/ /95						
		APP DOE								

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established 1959
Th S.M. toDer Corporation
700 Flatron Parkway
Boulder Colorado 8030
(30) 449-7220

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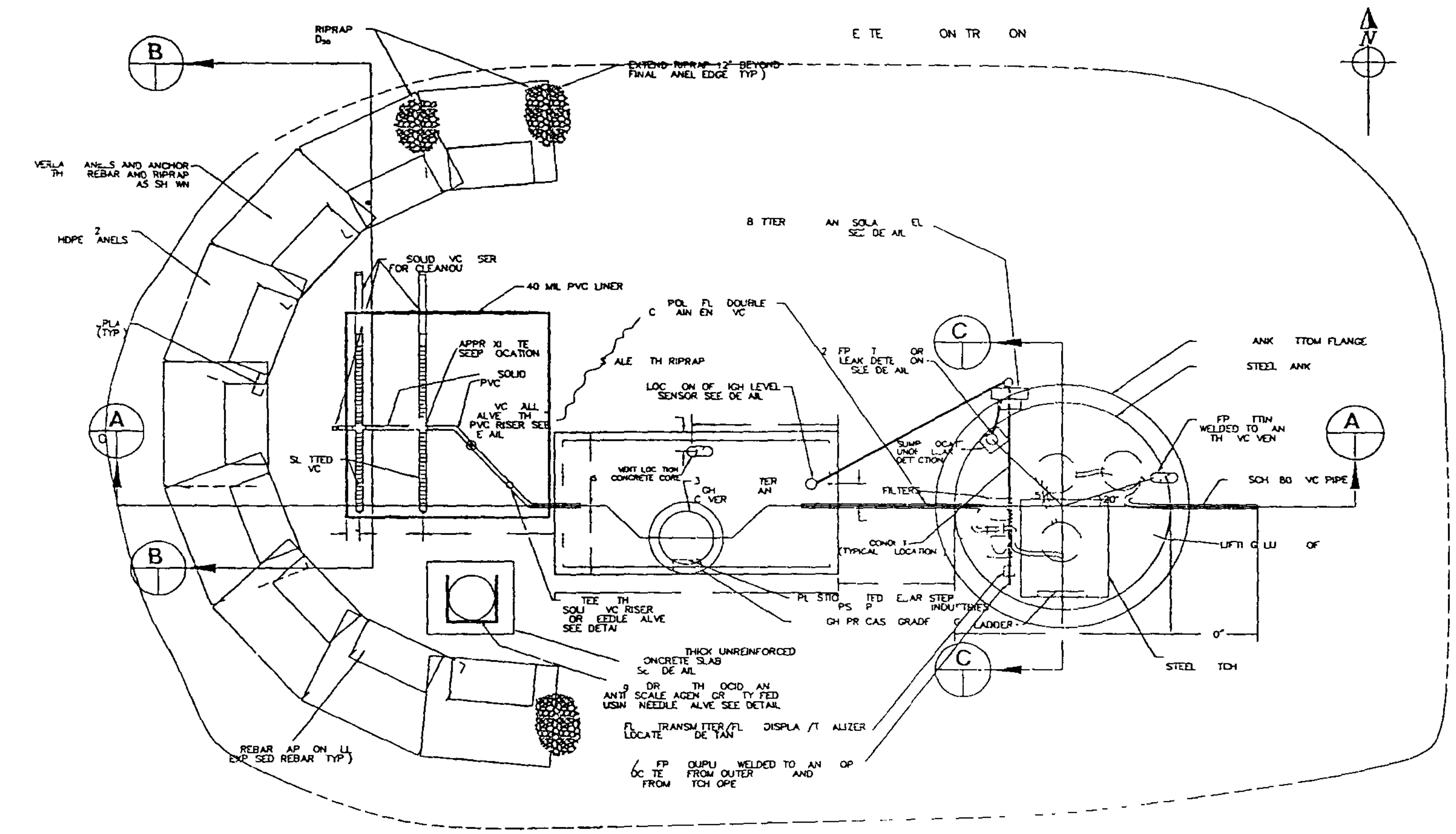
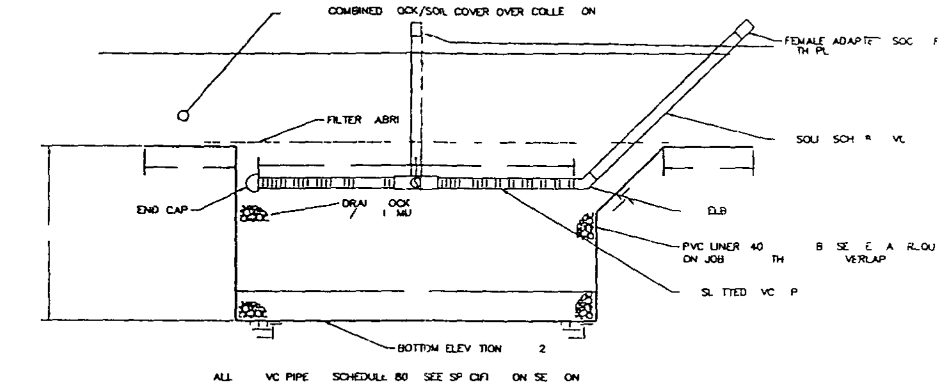


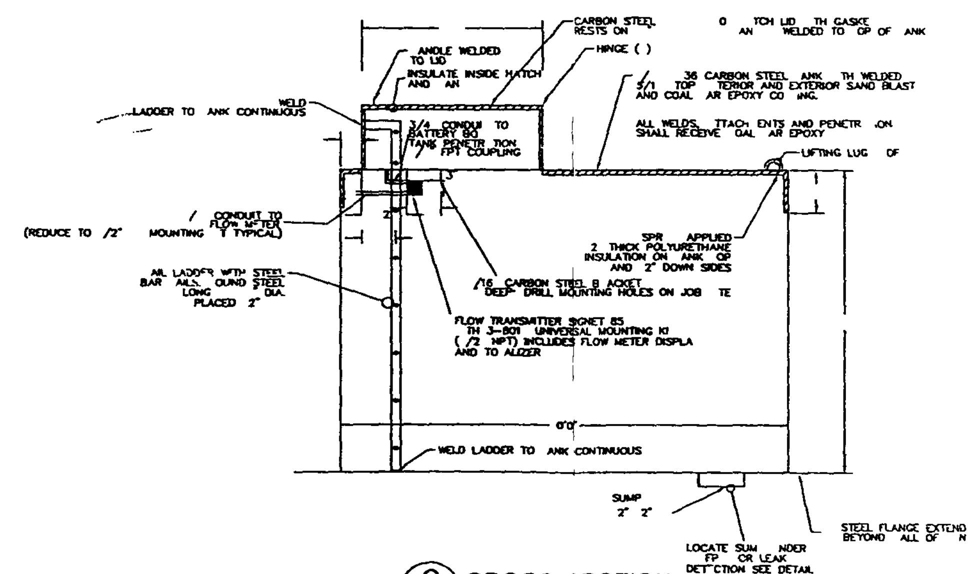
PLAN VIEW, PASSIVE TREATMENT SYSTEM

SCALE



B CROSS SECTION

SCALE



C CROSS SECTION

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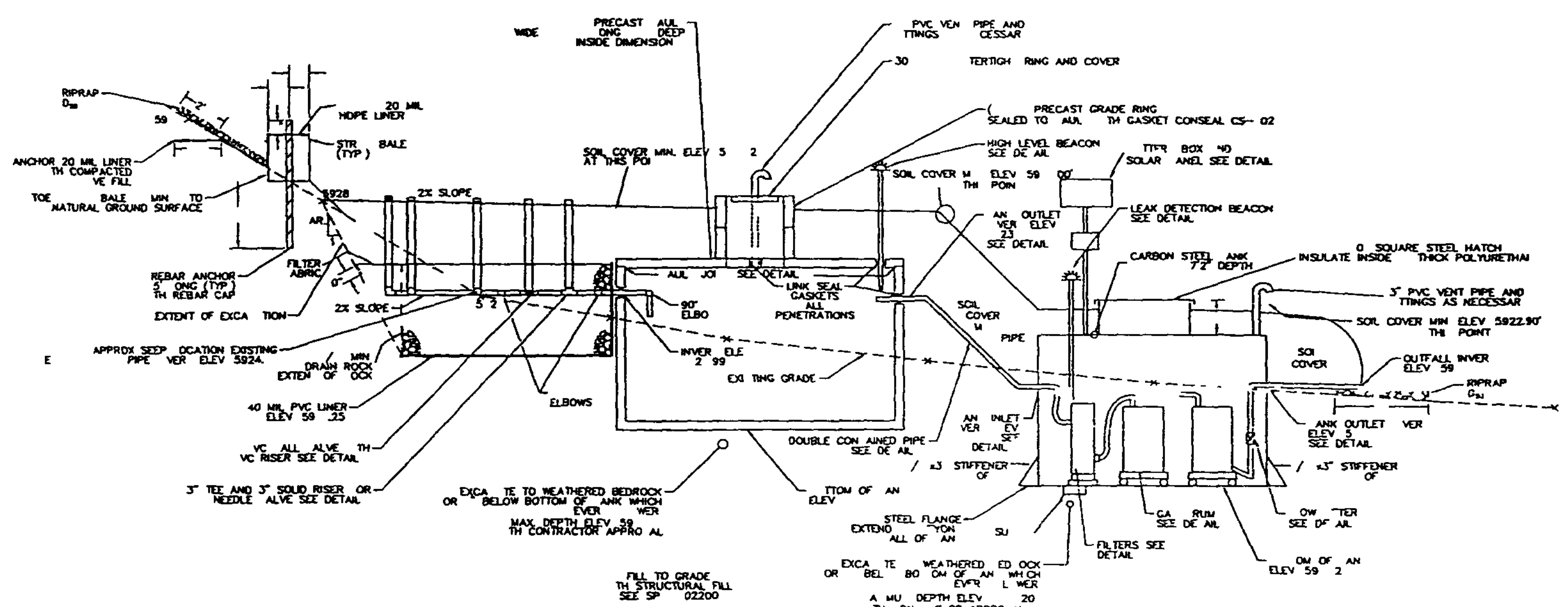

A CROSS SECTION

SCALE

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established 1959

The S.M. Stoller Corporation
700 Flatiro Parkway
Boulder Colorado 8030 -57
303) 449-7220

KEYWORDS	A	ORIGINAL ISSUE				
OU	ISSUE	DN	DATE		DO	JO N
2 LEACH TE		DESIGNED	JANKOUSKY	/95	US DEPARTMENT OF ENERGY	
3 REMEDIAL ACTION		DRAWN	CONRATH	2/95	GOLDEN, COLORADO	
5		CHECKED	CARLSO	2/95		
BUILDING FACILITY Site	UNLESS NOTED OTHERWISE	APPROVED	JANKOUSKY	/95	OPERABLE UNIT PASSIVE SEEP COLLECTION AND TREATMENT SYSTEM	
	REMOVE BURRS AND SHARP EDGES	REVIEWED	PICKERELL	/95		
	NEXT ASSEMBLY	REVISION	CARTER	/95		
	SCALE AS SHOWN	SUBMITTED / APPV RFP / APPV OE		9/21/95	D 51267 0 03	A 3 OF 7

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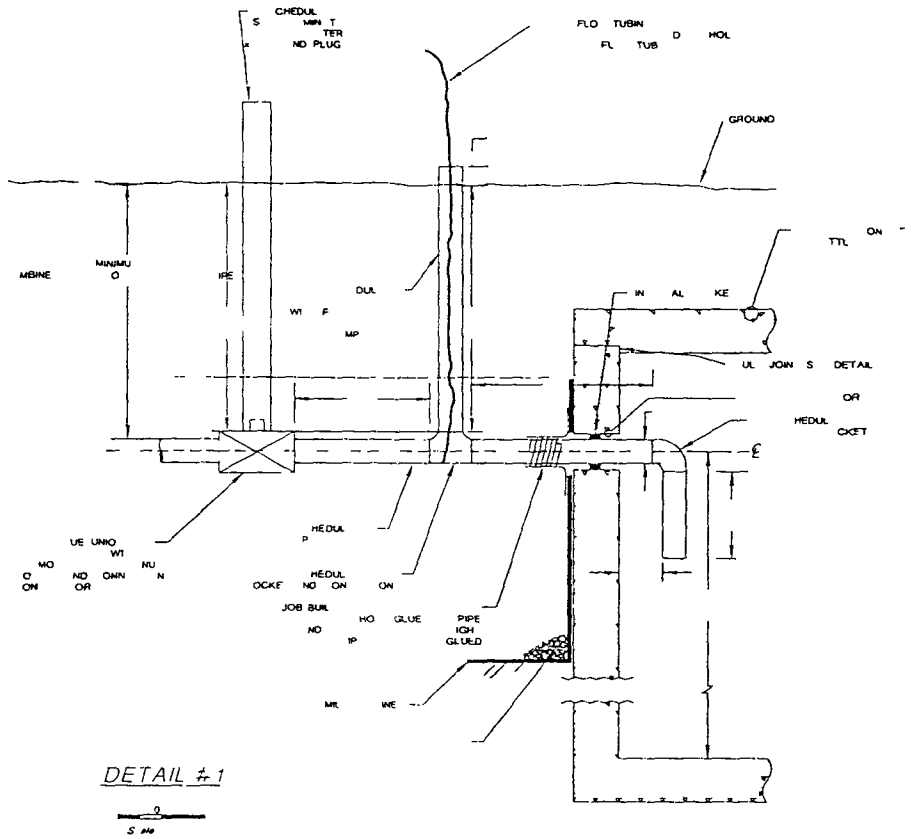
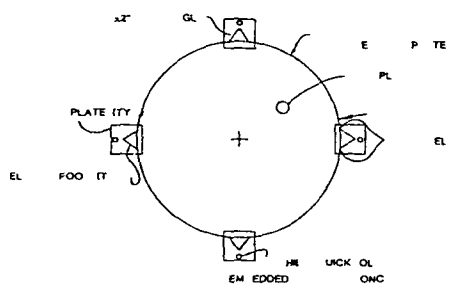
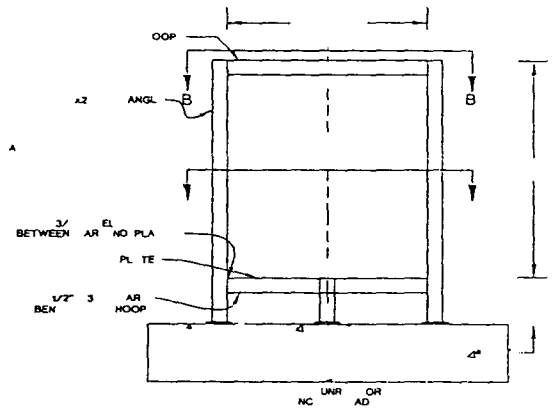


DETAIL #1

Scale



SECTION AA



DETAIL #2

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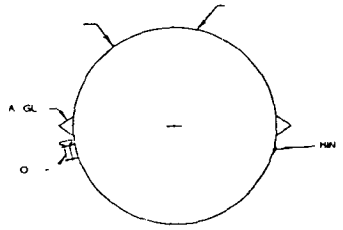
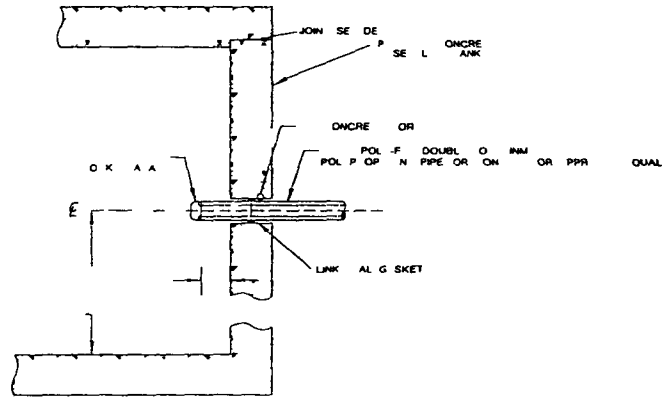
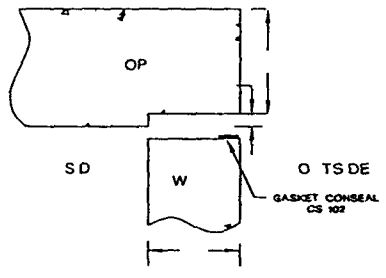


SECTION BB



DETAIL #3

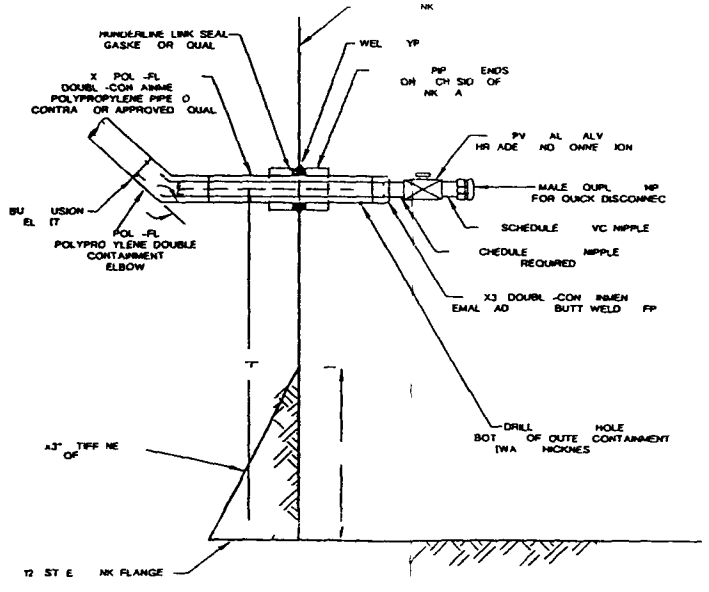
Scale F



DETAIL #4, CONCRETE VAULT JOINT DETAIL

SCALE

Scale Few



DETAIL #5

SCAL

Scale e

220

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established 1959
The S.M. Stoller Corporatio
700 Flatiron arkway
Boulder Colorado 8030
(303) 449 7220

EYWORDS	A	ORIG AL ISSUE				/ / 5	JL	K	BSC JL
1 OU	U				TE	TE		DO	S
2 LEACH TE	TOLERANC S FRA		DESIGNED	JANKOUSKY	7/95	U S DEP RTME T OF ENERGY			
3 REMEDIA CTION	ANGLE ±		CONTRA		/95	ROCKY FLA OFFICE GOLDEN, COLORADO			
AM	DE		CH CKED	CARUSO	/95	o vironmen ech olog			
5	UNLESS TED THERWISE		APPROVED	JANKOUSKY	/95	GOLDEN COLORADO			
BUILDING AGUITY Site	REMOVE BURRS AND SHARP EDGES		REVIEWED	PICKERD	7/95	OPERABLE UN ASSIVE SEEP COLLECTION			
ROOM AREA	NEXT ASSEMBL		REVISIOI	CARTER	/95	AN TR TMEN SYSTEM			
DRG COORD COL NO.			SUBMITTED			S VE TMENT YSTEM			
	SCALE. SHO		APPV RFP		9/21/95	DE			
			APP DOE			ZE D WI ER	ISSUE	SHEET	
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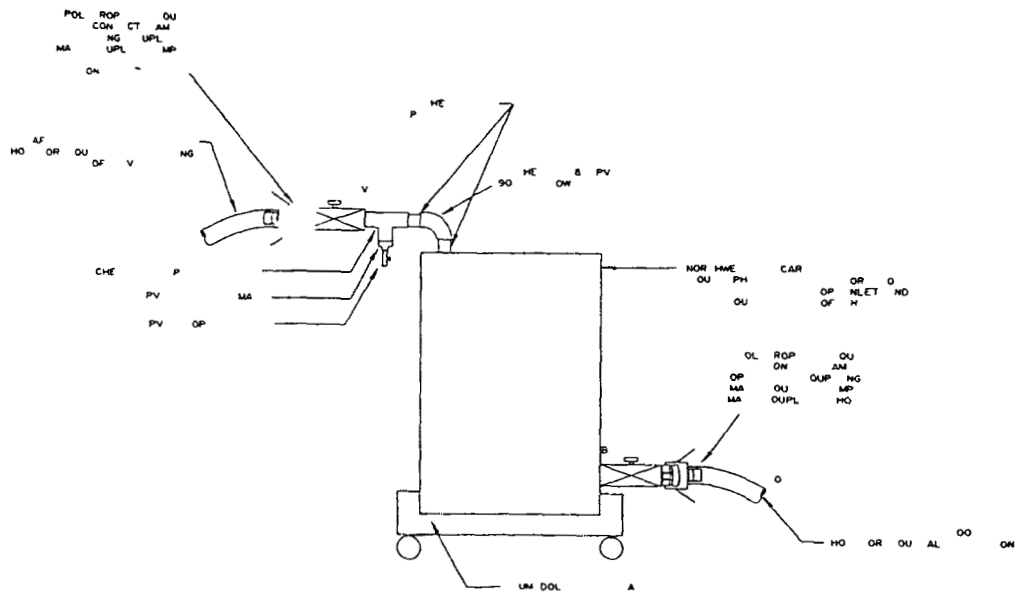
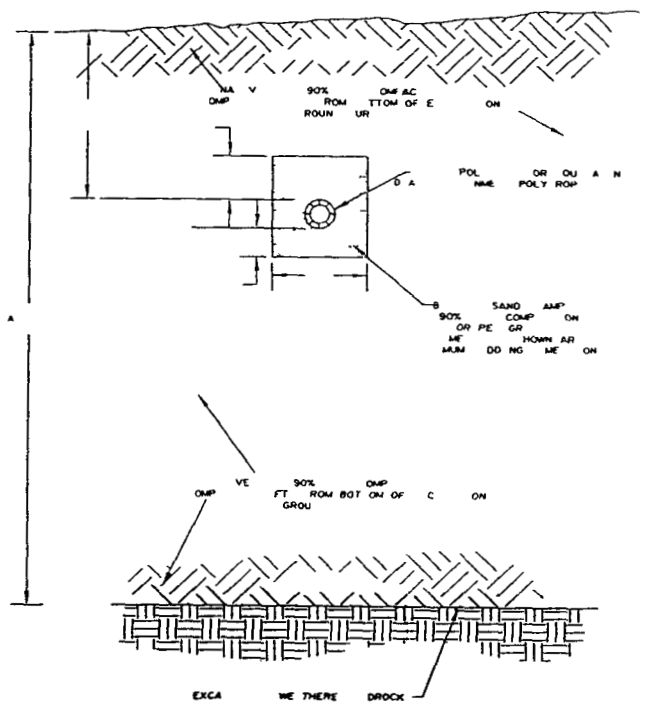


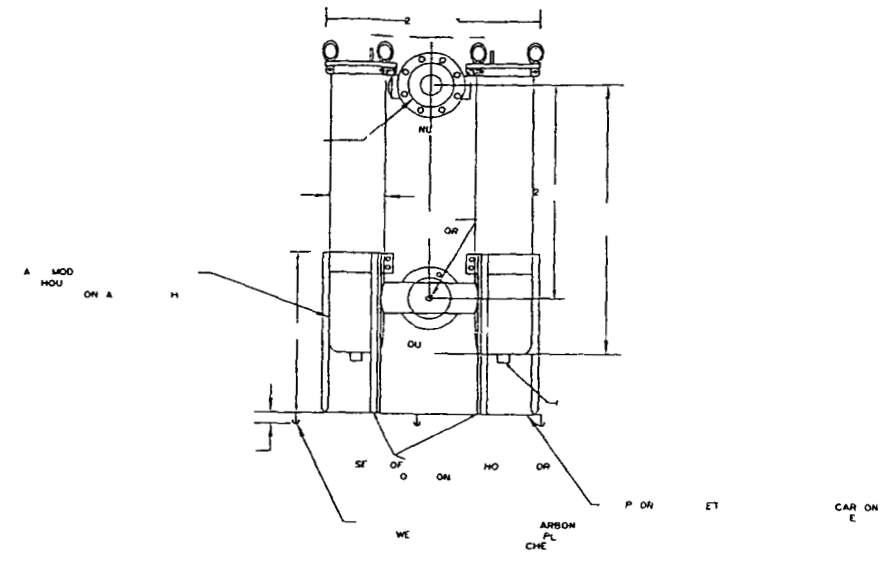
DETAIL #6

SCALE 0 S



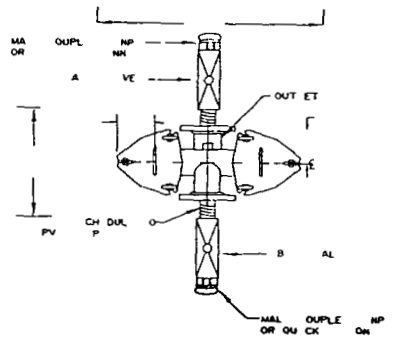
DETAIL #8, DOUBLE CONTAINED PIPE AND TRENCH

SCALE 0 Scale Fe



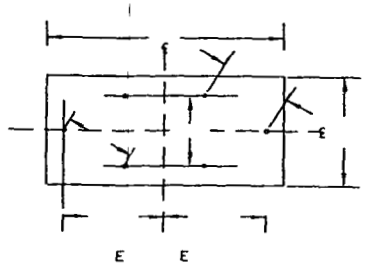
SIDE VIEW

SCALE 0 Fe



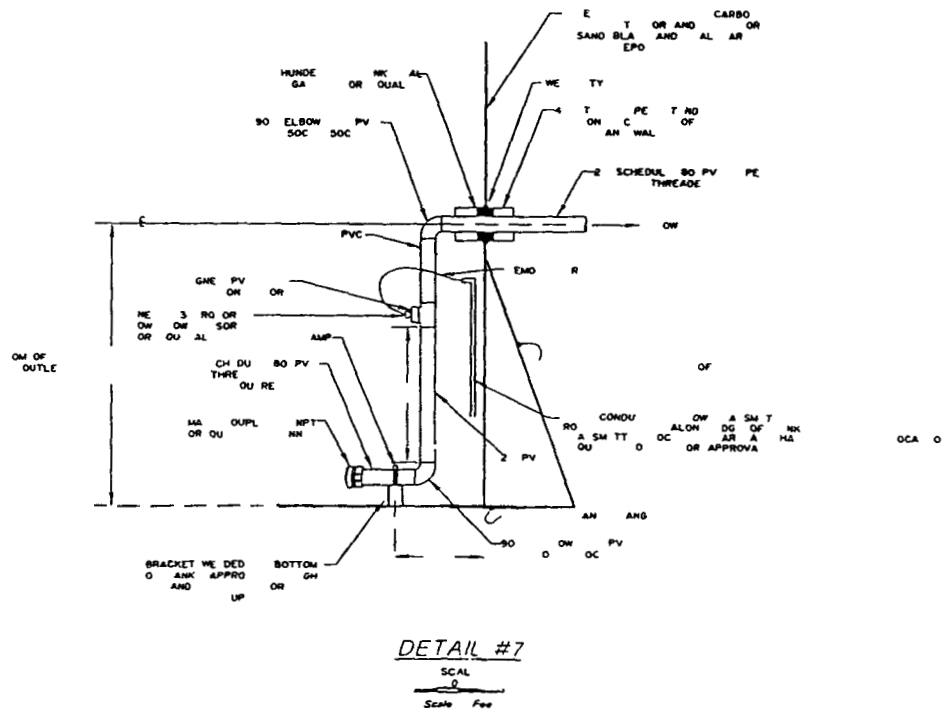
TOP VIEW

SCALE 0 Scale Fe



DETAIL #9, BAG FILTERS AND SUPPORT BRACKET

SCALE 0 Fe



DETAIL #7

SCALE 0 Scale Fee

221

Stoller
established 1959
Th Lolle rpor t
700 Fla tro Parkw
Bo) 220 rs 8030

KEYWORDS	A	ORIGINAL ISSUE			9/ /95	JL	SCA	981035
OU	UE	ION				TE		2510-012
2 LEACH TE	TOLERANCES			TE			DOE	A S JO NO.
3 REMEDIAL ACTION	FRAC	DE GNED	JANKOUSKY		/95	U S DEPARTMENT OF ENERGY		
AM	ANGLE ±	WN	CONRA		/95	ROCKY FLA OFFICE GOLDEN, COLORADO		
5	DE UNLESS NOTED THERWISE	CH CKED	CARUSO		/95	OC wronmen ech o Si		
BUILDING ACUITY 5 ft		APPROVED	JANKOUSKY		/95	GOLDEN COLORADO		
ROOM AREA	REMOVE BURRS AND SHARP EDGES	RE EWED	PICKERIL		/95	OPERABLE UNI NO. ASSIVE SEEP COLLE TION AND TRE TMEN SYSTEM		
GRID COORD COL NO.	NEXT ASSEMBLY	REVISION	CARTER		/95	SIVE TMENT YSTEM DE		
		SUBMITTED				ZE	W	ISSUE SHEET
	SCALE. SHOWN	APPV RSP				D	51267-0105	A 5 OF 7
		APP DOE						

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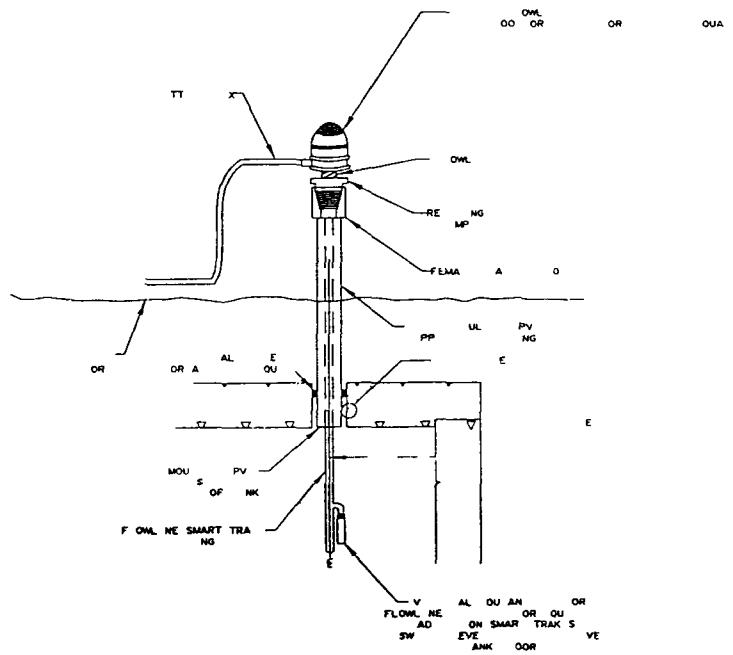
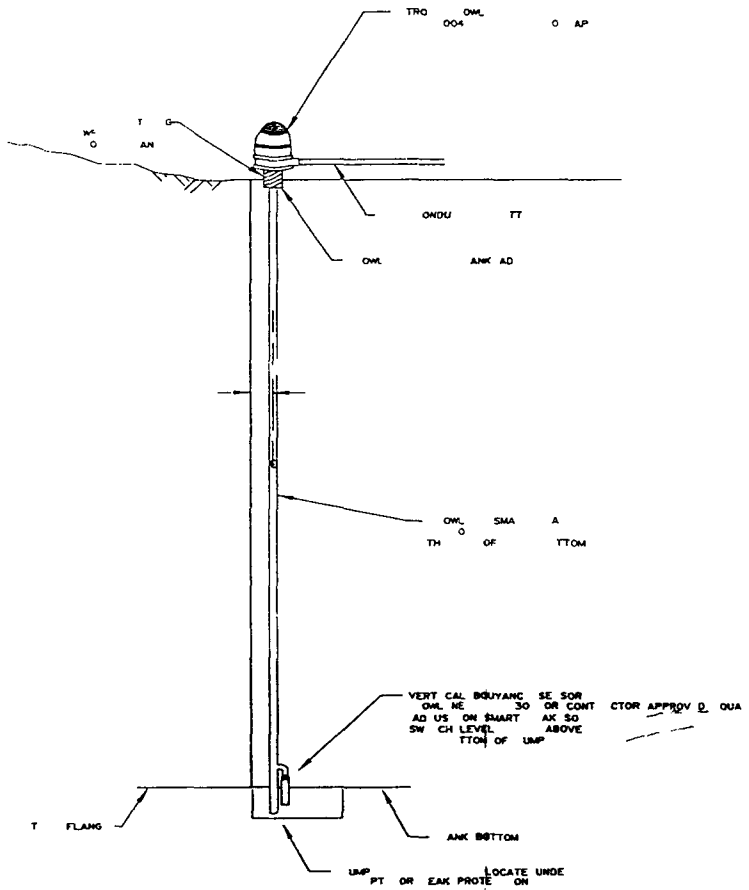


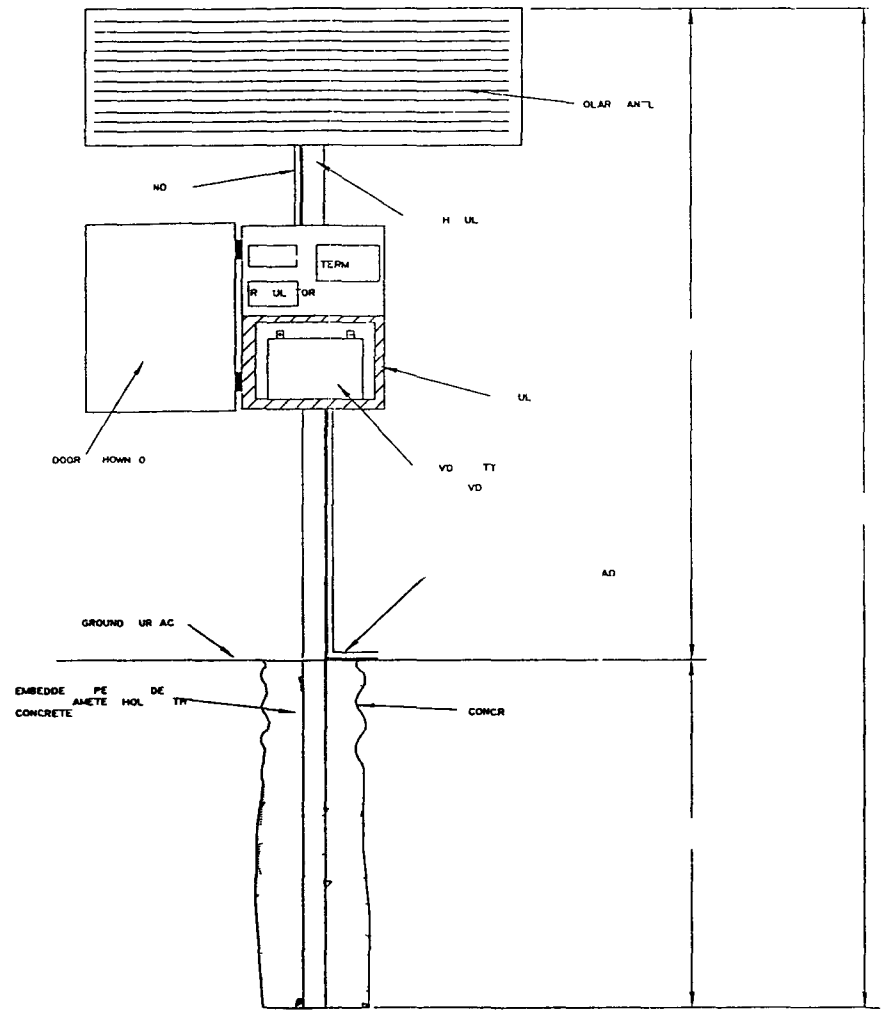
DETAIL #10, HIGH LEVEL BEACON

ALE
0
Scale Fee



DETAIL #11, LEAK DETECTION

ALE
0
Scale Fee



DETAIL #12, SOLAR BATTERY CHARGER PANEL

SCAL
0 0.5
Se

(SOLAR PANEL AND BOX NOT TO SCALE)

989035

KEYWORDS	A	ORIGINAL ISSUE															
1 OU		DE	IP	ID													
2 LEACH TE	TOLERANCES FRAC				TE												
3 REMEDIAL A TION	ANGLE ±	DE GNED	JAMOUSKY	7/95													
4 AM	DE	WN	CONRAD	7/95													
5	UNLESS NOTED THERWISE	CH CKED	CARUSO	7/95													
BUILDING ACUITY		APPR VED	JAMOUSKY	7/95													
S tp	REMOVE BURRS AND SHARP EDGES	REVIEWED	PICKEREL	7/95													
ROOM AREA																	
GRID COORD COL NO.	NEXT ASSEMBLY	REVISION	CARTER	7/95													
		SUBMITTED															
	SCALE	APPV RFP		9/6/95													
	AS SHOWN	APPV OE															

/ / S JL		SC JL J			9510-872
TE		DO	C	S	JO N

S DEP RTME T OF E ERG
ROCKY FLA OFFICE GOLDEN, COLORADO

oc En on en ec og
GOLDEN COLORADO

OPERABLE UNI NO ASSIVE SEEP COLLECTION AND TRE TMEN SYSTEM

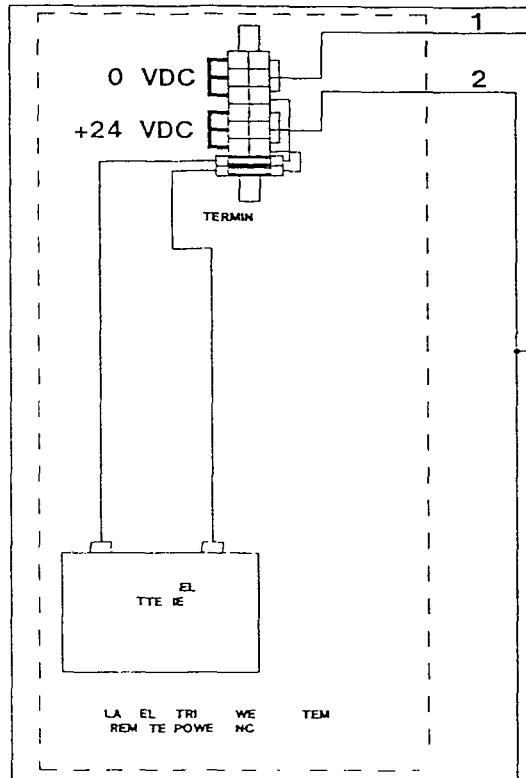
VE TMENT YSTEM
DE

ZE	WI ER	ISSUE	SHEET
D	51267-0106	A	6 OF 7

Stoller
established 1959
The S.M. Stoller Corporation
700 Flatiron Parkway
Boulder Colorado 8030 57
(303) 449-7220

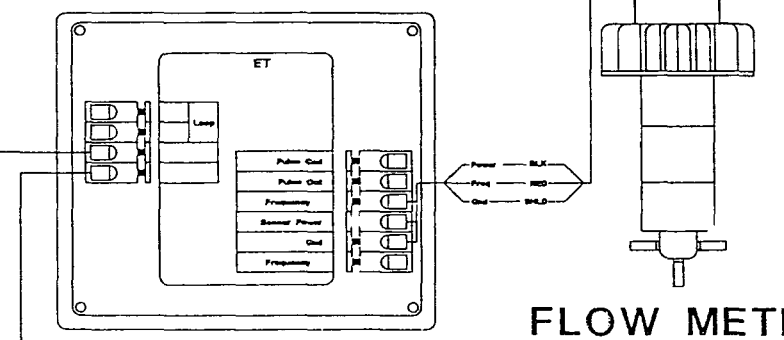
222

RADS1670 A



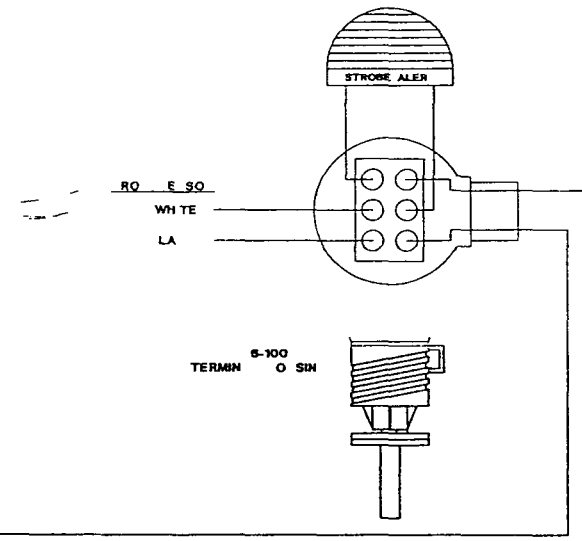
SOLAR BATTERY CHARGER PANEL

FLOW TRANSMITTER

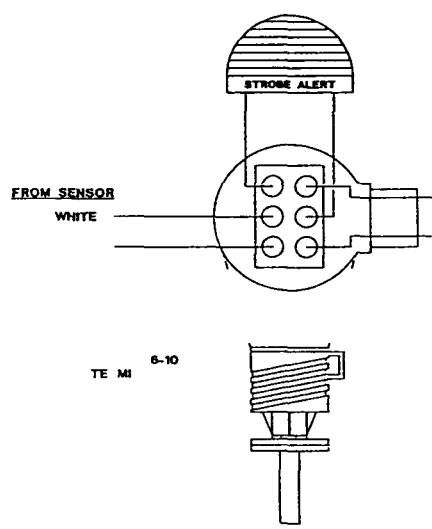


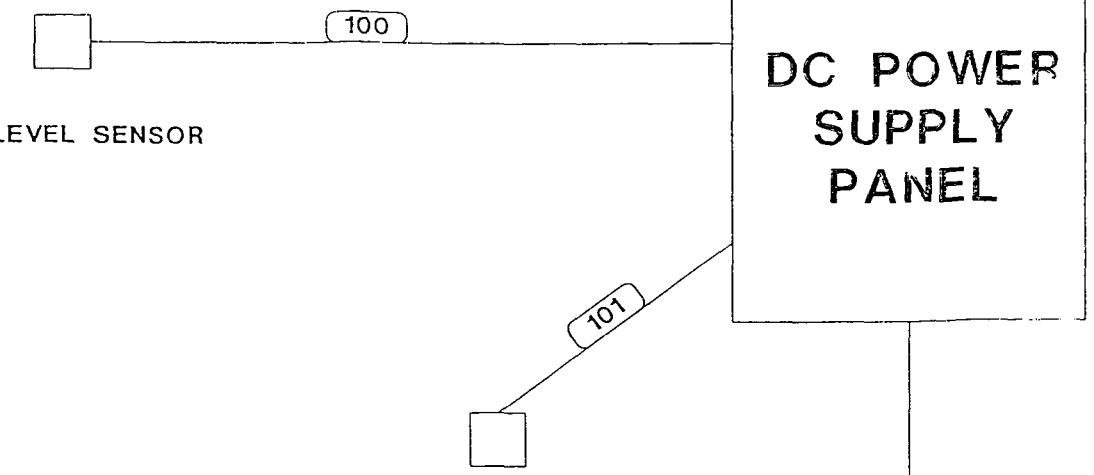
FLOW METER

DC STROBE LEAK DETECTION



DC STROBE HIGH ALARM





RISER DIAGRAM

C E U E				
ONDUIT No.	ONTROL CONDUC	SIZE	WIRE TYPE	COMMENT
0			T	GH-LEVEL INDIC O Sflowline Y10-130 ertical Buoyancy ensor Sflowline C09 1004 DC trobe Alert, Sflowline C06-1001 Junction Bo erminal trpl.
1			TH	LE DETE TION INDIC TO lowline Y10-1301 ertical Buoyancy Sensorl Sflowline C09 1004 DC trobe Alert, Sflowline C06-100 Junction Box erminal trpl.
10	1		T	FLOW RANSMITTE Signet 8511 ompact Flow ransmitt
102A	U UPPLIED		TH	FL METE Signet 535 otor -Low-Flow Sensor

REP ED H MM EN

STOLLER

established 1959

Th S.M. Stoller Corporation
700 Flatiron Parkway
Boulder Colorado 8030
(303 449-7220

KEYWORDS	ORIG L ISSUE														
1 OU	SSU	DESCR GN					TE		TR	TR	BH	TRS		2570642	
2 LEACH	TOLE FRAC	CES /X				TE		TE	FP		OE	CLA	JO		
3 REMEDI TION	ANGLE ± XX		DESIGNED	SELLS	/9		S DEP RTME T OF ENERG								
4 AM	DE XX		WN	ELLS	9/9		ROCKY FLA OFFICE GOLDEN, COLORADO								
5	UNLESS TED		CH CK	BJHEM A T	/		ock Flats Plan								
BUILDING ACILI	THER SE		APP VED	SELLS	/9		GOLDEN COLORADO								
Site	REMOVE BURRS AN		REVIEWE	G.PICKEREL	9/9		OPERABLE UNI NO SEEP COLLE TION AND S ORAGE OILITY								
ROOM AREA	SHARP EDGE						LE IC CHEM TIC ND ISE DI M								
GRID CODE COIL NO.	EX ASSEMBL NEX														
	SUB TITED						ZE	W M ER			ISSUE	SH ET			
	SCALE.	APP RFP			9/2/88		D	51267-0107			A	7 OF 7			
	S LE	APPV DOE													

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+24 VDC

O VDC